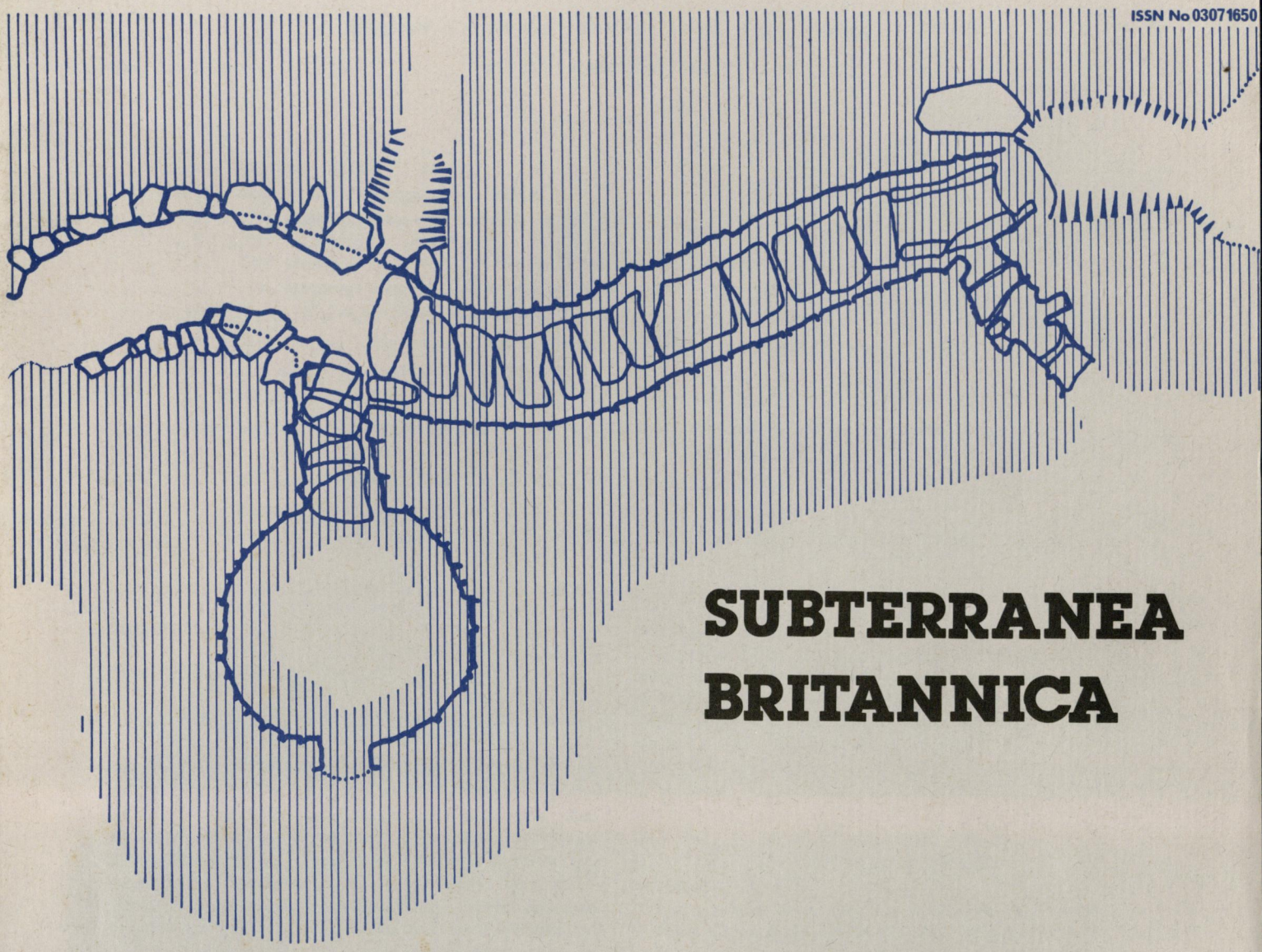
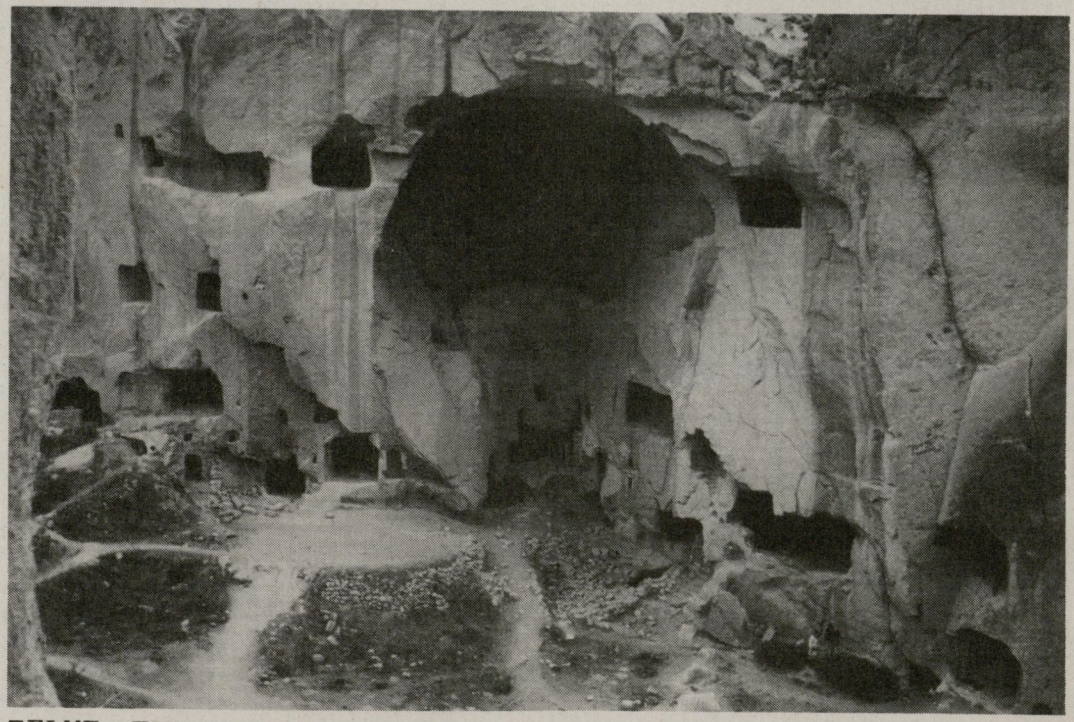
ISSN No 03071650



SUBTERRANEA BRITANNICA



ZELVE, TURKEY

Bulletin No. 25

THE BULLETIN OF SUBTERRANEA BRITANNICA

No 25 - February 1989

CONTENTS

EDITORIAL

Sylvia P. Beamon

At the SFES Conference held in Arfeuilles, Bourbonnaise, in July 1988, Guy de Block (SOBERES) of Belgium raised the complicated practice of prefixing conferences and symposiums held in our respective countries as "International". Any conference, to which members from other countries have been duly invited, has recently become an International event. Firstly, by inference it gives the outsiders the feeling of being welcomed into the fraternity and secondly, and most importantly, it gives everyone involved the opportunity to liaise and exchange information. However, there is a very real problem - who or which country is going to host the International Conference in any one year?

In the June of 1986, at the Dutch "First International Symposium on Underground Quarries", it was agreed that the Belgians should hold theirs the following year and SEHDACS (France) based in the Paris area, in 1988. At the Reves, Belgium, symposium (1987) the newly contacted Italian society said they would host one in 1988, then it was requested that Subterrania Britannica prepare one for 1990, to which we readily agreed. A complication set in at Arfeuilles as SFES had Perigord booked for a conference for 1990 and we were asked to bring forward ours to 1989. The dates had to be altered too, as France is holding its Bicentennial activities associated with their past revolution around the 14th July. We accepted the situation, the Bristol/Bath area was approved and the end of July adopted as the most suitable time to fit in with the Continental holiday period ... And what did we receive a couple of weeks later, SEHDACS information sheet with booking forms for 1989! They had been overlooked.

Since most members belong to, or are associated with, the various like-minded groups, each conference generally draws on the same people, which from a financial and time point of view dilutes the impact. Guy de Block has promoted the suggestion that an "International Conference" should be held only ONCE every four years, with full translation facilities. The host country will then have more time to organise the event and everyone else will know exactly the date and where it will be held well in advance. It means that each country can continue to have their own "Conference" and invite members from other countries to attend if they so wish, as we do ourselves when we hold our annual Study Weekend.

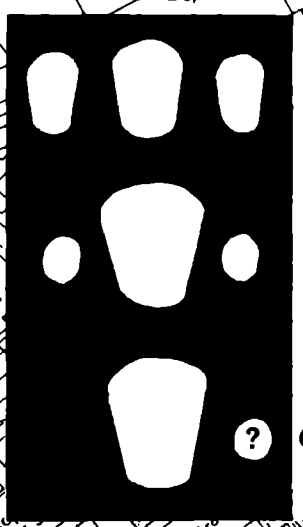
This Bulletin is the official publication of Subterranea Britannica.

The Bulletin has been compiled and edited by Sylvia P. Beamon (2 Morton Street, Royston, Hertfordshire SG8 7AZ) with assistance from Chris Bayley, Sandy Dehnel, Deryck Laming and Jenny Plumer.

High Lode Culvert

Ramsey, Cambridgeshire

TL 2881,8504 & 2846,8565
1;2500. cross sections X 10
surveyed by A.R.Jarratt & R.Smith 6·7·87



RAMSEY

lower ent.

upper ent.

sluice chamber

UNDERGROUND CAMBRIDGESHIRE, PART I:
A: HIGH LODE CULVERT, RAMSEY

A.R. Jarratt

The Fens are hardly renowned for their subterranean features but anyone visiting the ancient market town of Ramsey is well advised to visit the impressive series of brick-lined culverts running the length of the wide main street - the Great Whyte. The writer recently spent a month working in the town and only found out about this "underground river" due to a chance reference to photographs of it in a local pub!

The main culvert carries the Bury Brook from just S of High Street for some 707 m to emerge near a converted corn mill on the NW edge of the town. The passage has an average width of 3.5 m and is some 4 m high in places. Access is easy from either end, though wading is necessary at the lower end where the underground stream flows into the High Lode drain. The possibility of flooding should be borne in mind, as a postcard dated 26.8.12 held by Huntingdon County Records Office (ref. PH/63/1/3) shows the water level at the top of the arches.

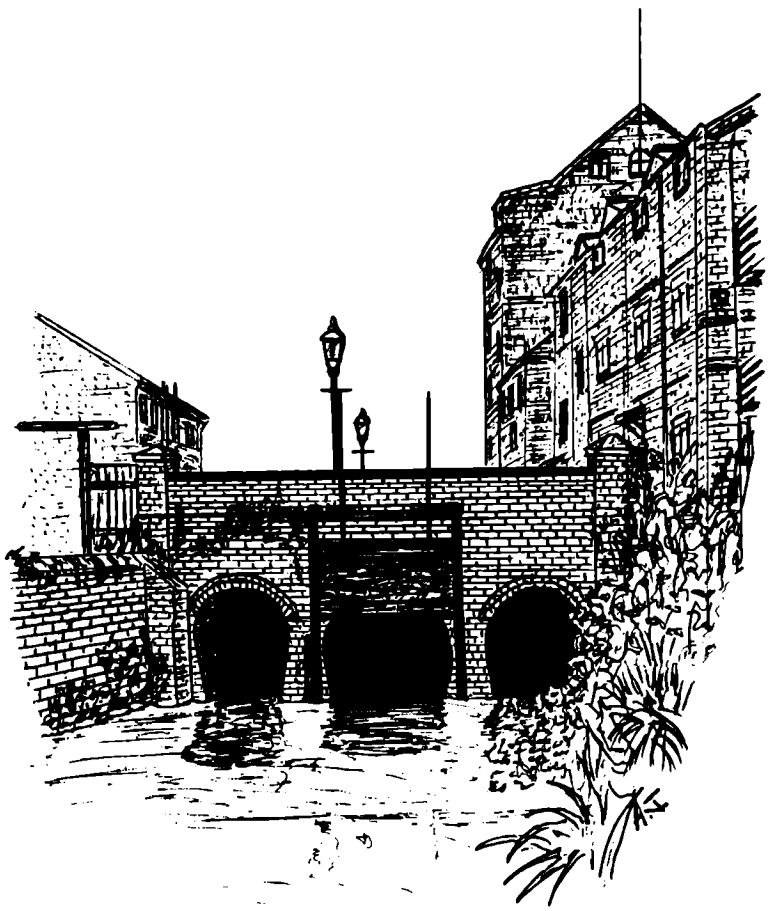


Figure 1. High Lode Culvert, Ramsay - lower entrance

Parallel to the main culvert are two smaller raised tunnels once used as sewers which branch off to E and W near the top entrance. These were not explored or surveyed due to the nature of their contents, their odour and the vocal objections of the resident rat population. There is scope for a considerable length of passage for those not minding a nose full of rodent teeth!

The main point of interest in the culvert is an underground sluice chamber with much of the winding gear in situ and some fine displays of straw stalactites nearby. The 'Jolly Sailor' pub, in the Great Whyte (directly above the culvert) has some good photographs of this in the bar and is the source of much local knowledge on the site. One story tells of the burst of 1853 being caused by irate farmers tipping bricks into the top entrance. Another is that the main culvert was used as a water supply - hand pumps being installed in the Great Whyte above. This would have been most interesting in flood when the side sewers were flushed out!

Reports of a plaque above the top entrance bearing the date 1854 were not substantiated. The culvert is locally known as either "The Arches" or "Great Whyte River". The present 1:2500 O.S. plan names the stream at the top entrance as High Lode but this would seem to be inaccurate - Bury Brook being more correct, High Lode being the once-navigable drain at the lower entrance, formerly known as Bill Lode.

Due to lack of time, only a small amount of research was carried out and the three relevant references found are reprinted below. Further information may possibly be obtained from Ramsey Estates Office, Anglian Water Authority and from unchecked papers on culvert repairs in Huntingdon Records Office.

The main culvert was visited by Martin Grass (Bristol Exploration Club), Tony Jarratt (Bristol Exploration Club and Subterranea Britannica) and Rodger Smith on 20 May 1987 and surveyed with tape and compass by the latter two on 6 July 1987.

NOTES

1. *Dr Airy's Report to the Local Government Board on the Sanitary Condition of Ramsey (Huntingdonshire)*:
George Buchanan, Med. Dept. 14 October 1875. (Huntingdon County Record Office ref: X212/2124).

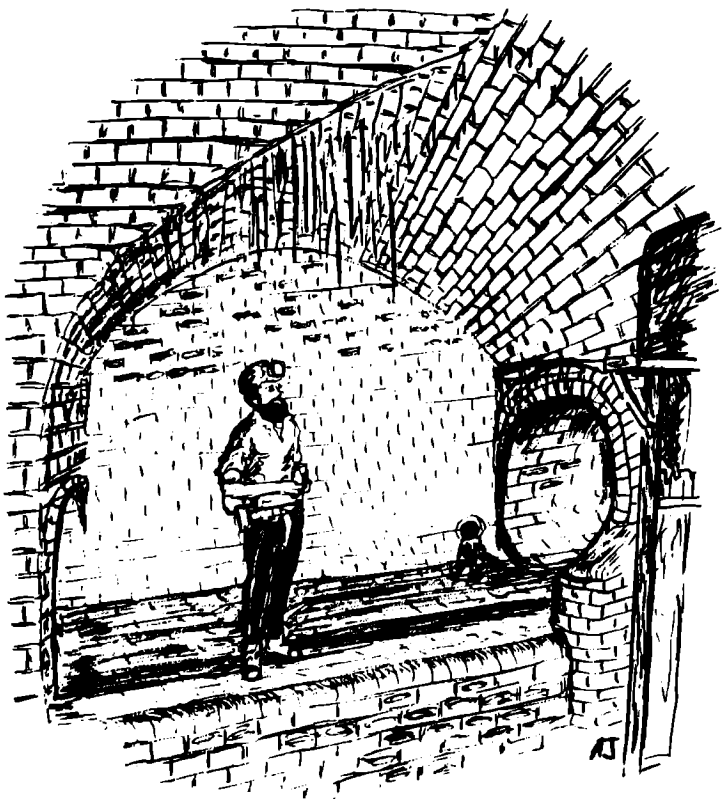


Figure 2. High Lode Culvert, Ramsay - sluice chamber

"The drainage of the town is peculiar. Two sewers are laid under the High Street, beginning at opposite ends of the town, east and west, and descending as though to meet in the covered channel of the Bury Brook; but there they are diverted and carried parallel to the brook on either side of it in separate channels until they emerge and mingle their contents with the brook and with one another in a small basin where barges are moored, at the head of Bill Lode. The brook itself is liable to be greatly swollen by heavy rains, and therefore requires a large channel. It was first covered in, nearly thirty years ago, by a single culvert, but the brickwork gave way during a heavy flood. In its place two culverts, side by side, were constructed in 1854, and have lasted to the present time. They are approached from above by a single arched channel, almost circular, about 10 feet [3 m] in diameter, which extends for about 100 feet [30 m] under the road before the double culvert begins. At this point there is access to the sewers on either side by wide lateral openings from the great archway, and penstocks are arranged at the entrance to the culverts so that, if desired, the water of the brook can be prevented from entering the culverts and made to flush the side sewers; or, in case of unusual flood, the side sewers can be made to serve for the escape of part of the flood waters. This has been a great and costly work for so small a town. The mouth of the great archway which leads to the sewers and culverts opens between and under the back windows of the outermost dwellinghouses on the south side of High Street. An offensive smell arises from it, especially when the wind blows up from the other end. I think, for the health of this part of the town, it would be well if the archway were continued some distance further up the brook channel. At a point about 30 yards [27 m] above the great archway the brook is dammed up to store the water in summer for washing or flushing.

"The sewers above described receive surface water and house slops, except what goes to cesspools and pits in rear of the cottages. A few waterclosets are connected with the sewers, but not enough to give the contents a decidedly faecal character. The branch sewers were carefully laid eight of nine years ago. The lateral drains are 12-inch glazed pipes. The street gully holes are trapped, but sometimes dry. There is no ventilation to the sewers except by the openings into the brook archway, and no sufficient means for flushing the sewers in their upper course."

"The basin at the head of Bill Lode, into which the culverts and sewers empty themselves, becomes a nuisance in hot weather. The water in it is practically stagnant, for it receives little or nothing from the Bury Brook except in flood time, and there is no branch channel by which a circulation of the water could be established. The sewerage of the town, along with refuse from barges, accumulates in the basin and, undergoing decomposition at the bottom, gives off offensive and noxious gases which rise in bubbles to the surface, especially when stirred by barge poles. It would be well if the Local Board would consider what can be done to purify this basin and keep it clean, either by adopting some process of precipitation of the solid part of the sewage before the liquid part is allowed to enter the basin, or by carrying the sewers further down before they discharge into the Lode. The question is important because the railway terminus stands at that end of the town, and dwellings are likely to multiply around it."

2. *The Victoria History of the County of Huntingdon*, vol. II, p. 189

"Great Whyte is a peculiarly wide street and formerly included in its width a stream which ran from Wistow and Bury and became the High Lode north of the Great Whyte. The High Street passed over this stream by the Great Bridge or the Old High Bridge said to have been of one pointed arch. The stream down Great Whyte was covered in by a tunnel of three spans, begun in 1852 and finished two years later."

3. *Ramsey - Offical Guide*, p. 6

"The Great Whyte - the name has been spelt at different times as Wight, White or Wait - is now an unusually long and wide street and one of the features of the town. The excessive width was caused by the covering over of the Bury Brook which originally ran down its centre as an open waterway, navigable by small boats. In 1852 it was decided to culvert the brook and a single long tunnel was constructed. This, however, proved inadequate to cope with flood water and burst, so two additional culverts, one on either side were added two years later. The impressive exits of these tunnels may be seen near the mill at the northern end of the street."

B: CAMBRIDGE

Lena Clark has brought to our attention the following information summarised from the book The Cambridge Nobody Knows *by F.A. Reeve, published by the Oleander Press, 1977.*

Pease Hill

Beneath Pease Hill, near St Edward's Church, there are vast cellars covering a quarter of an acre. Two of the 'tunnels' are a hundred yards [95 m] long. They were once used as wine vaults, and during World War II some four hundred people used them as an air raid shelter. The Town Rental Book for 1878 records that William Potts paid 1s 3d (old money) "for a cellar under Market Place, in front of The Three Tuns there, as by licence from Council 1870 ..." This celebrated inn later became the Central Hotel and later still a hostel for King's College. The inn's cellars reached to the rear of the houses in King's Parade (p. 23).

Entrance lids to the cellars of Pease Hill can still be seen between the church and fence (illustrated p. 24).

Emmanuel College

"When Emmanuel College were making plans for their North Court (1912-14), there were negotiations with the Council about the possibility of closing Emmanuel Street, but fortunately a subway was built below the street" (illustrated in the book).
(This tunnel has given rise to the local story of a 'secret tunnel' - Ed.)

The Conduit of the Franciscans

In 1325 the Franciscan Friars (now Sidney Sussex College) acquired from seventeen different owners a strip of land one mile [1600 m] in length and 2 ft [62 cm] wide from Bradrusshe (now Conduit Head Road) to the Friary. They provided a wellhouse and a pump fixed to the outer wall of their establishment and Sidney Street for a long time was called Conduit Street, even many years after the Friary had been dissolved.

In 1439 Trinity College, known then as the college of King's Hall, obtained the right to tap the conduit as it passed through their site. In 1538 full rights went to Trinity College. This water, since supplemented by an artesian well, continues to feed the fountain in the Great Court. A tap still stands there in a small alcove with a small notice proclaiming "This water is not fit for drinking". The college has peculiar rights enabling it to prevent owners of land, through which the conduit passes, from building over it in a manner which would prevent access to it throughout its course. The route for the piped water, about 300 yds [275 m] W of the Observatory, runs under Madingley Road, through fields, gardens, St John's Wilderness then crosses the river opposite the N end of Trinity College Library, under the hall to the fountain and hence to the Great Gate (see also *Subterranea Britannica Bulletin* No 20, pp. 19-20).

Downing College Brewhouse

Before the present shops were built on both sides of Regent Street, a Professor Henslow lived in a house on the Parker's Piece side, and his stables were on the opposite side which was the site of the former Downing College brewhouse. An underground passage was constructed to connect the house and the stables; this was visible during building operations in 1897 (p. 23).

C: TUNNEL FROM BARNWELL PRIORY TO ST RADEGUND'S, CAMBRIDGE

Tom Doig

"Early in the 1880s the Borough authorities were considering the respective merits of various schemes for a new drainage system for the town [Cambridge]. Among the many proposals put forward was one by the late George Bullock, a builder and native of Cambridge and his [printed? -illeg.].

"*Report to the Cambridge Improvement Commissioners*, dated April 5, 1884, contains the following:

"The characteristic and distinguishing features of my scheme are, that the intercepting sewer shall be constructed as a tunnel and shall be [made? - illeg.] in the solid Gault.

"Leave having been obtained, Bullock duly constructed an experimental section between Victoria Avenue and Fair Street at a depth of about 60 ft [20 m]. Bullock's scheme, however, was not accepted by the Commissioners, but this 'Maids Causeway Tunnel' will remain a long and lasting, tho' hidden, memorial of his work and name. - A.B. Gray"

References:

Notes made by Miss Enid Porter, c.1965.
Originals held in the Cambridge Folk Museum - ref: Cambridge Vol. 3, p 101.
Reeve, op. cit. 1977, p. 23

D: THE MANOR OF BURGHERST, Grantchester Manor House, Cambridgeshire

Tom Doig

"The rooms intended for the family were built on massive cellar walls. Concealed in one of the cellar walls is a curious narrow chamber, 20 ft long and 3 ft wide [6 m by 1 m] built with huge stones and vaulted. It was entered by a trap door from a room above and was most likely a secret hiding place in times of danger. It was long supposed to be part of a subterranean passage to King's College Chapel.

"A legend tells how a fiddler (*vide* Anstey) once undertook to explore it and entered, playing his fiddle. This was listened to as it died away - but he never returned, and after a time the passage was stopped up. Part of the end wall has been removed showing that it went no further.

"There is a real subterranean passage from the cellar. It can be crossed for about 20 yds [18 m] where it is bricked up to prevent burglars entering (which did once happen). It is 50 ins [1.27 m] high and 20 ins [50 cm] wide."

References:

Notes made by Miss Enid Porter, c.1960, and possibly transcribed from notes made by S.P. Widnall in 1875. Original manuscript held at Cambridge Folk Museum - ref: Villages 2, p.1.

MUSEE DE LA MINE - LE MOLAY LITTRY, LOWER NORMANDY

Paul W. Sowan, B.Sc., F.R.G.S., F.G.S., F.L.S.

The two parishes Le Molay and Littry, both entirely agricultural and now joined into one, 10 km or so to the southwest of Bayeux in Lower Normandy, were formerly the centre of a quite extensive minor coalfield worked from 1741 onwards. The last mine closed in or about 1950, but as early as 1902 a museum devoted to the local pits was established; this continues to operate and is of considerable interest and well worth a visit.

Although not on the scale of Beamish or Ironbridge, the museum is nevertheless a valuable exercise in industrial archaeology and history in a country where such things appear to be somewhat neglected. The display comprises a small theatre where an audio-visual introduction (currently available only in French) is presented. The visitor then proceeds to the 'Historic' display room, from which point on a most helpful tape recorded commentary in English is provided (or in French, if preferred!) The magnificent centrepiece is a large 1798 steam engine, constructed by J.-C. Perier for the Littry mine, and used for raising both coal and water from the shaft. There is an excellent collection of artefacts and documents, entirely or mainly of local provenance, illustrating methods of working and transport, conditions of working, and so forth.

There follows a 65 metre 'mine gallery' (wholly above ground), very effectively reconstructed and stocked with

exhibits to demonstrate the development of mining techniques and conditions underground during the life of the Molay/Littry mines. Finally, there is a further display hall devoted to more modern mining methods with, as centrepiece, a huge and incredibly detailed scale working model of a late 19th century mine buildings and machinery, constructed in 1890 by students at the French School of Mines. In the grounds there are a tall square stone chimney stack - evidently one of the few remaining tangible relics of the industry - and various items of mine rolling stock. There is a useful short guidebook (in French), a set of five postcards of the museum, and various more voluminous and detailed publications dealing with aspects of the coalfield and its mines.

GRAN CANARIA - THE 'QUEEN BEES' OF CENOBIO DE VALERON?

Sylvia P. Beamon, MA, Subterranea Britannica

Paper presented at the Societe Francaise d'Etude des Souterrains Congress at Arfeuilles-Glozel, France, 14-17th July 1988.

Cave-dwellings were known throughout the Canary Islands Archipelago. To make a cave habitable, sometimes the gaping mouth was walled to form a smaller entrance, stone slabs brought in as seats, stone beds built against the inner walls and surfaced with gravel: these beds were then padded with dry grass or bracken covered by skins as the actual bedding. Cooking was carried out close to the mouth of the cave. The floor, which was likely to have been levelled, was spread over with a layer of vegetable matter. Eventually, the dwelling might have become its occupants' sepulchre. (The vegetable layer is considered by some modern archaeologists as belonging to the burial ritual itself).

It seems that artificial caves in that area occur mainly on Gran Canaria. Cave-cutting was a specialist task during the time of conquest by the Spanish in the 15th century and was executed by using animal bones, stone tools and, in some cases, probably with metal tools. It has been definitely established that early in the 14th century, if not before, the Canary Islands were inhabited by a race of light-coloured aborigines called "Guanches" and many were captured as slaves by the Spanish and Portuguese. It is believed that they were of Berber stock and possibly came from North Africa. Their agriculture on Gran Canaria was primitive and dogs and goats were their only animals. They had no written language, clothing was

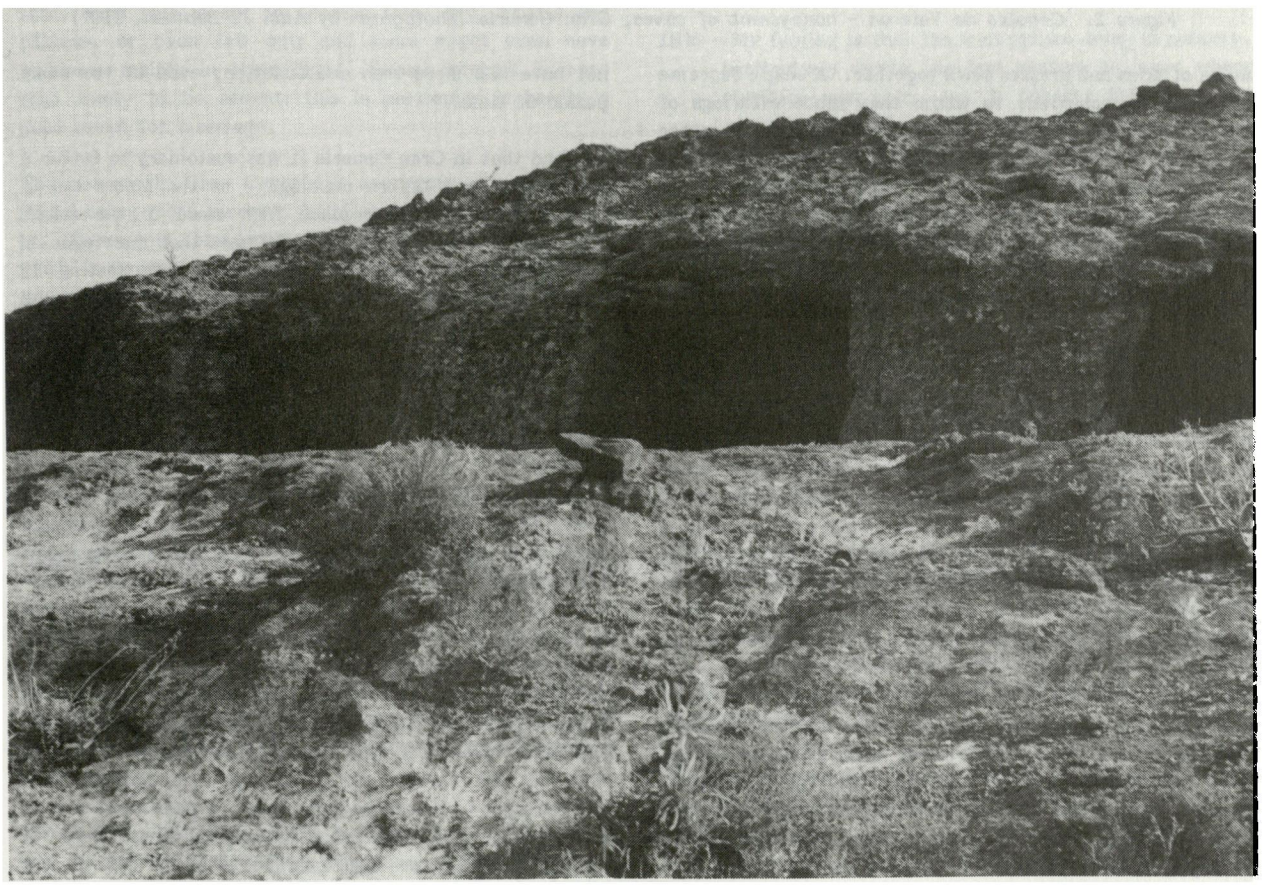


Figure 1. Guanche Indian Council Hall, near Telde, Gran Canaria (photograph by Alan J. Beamon, 1987)

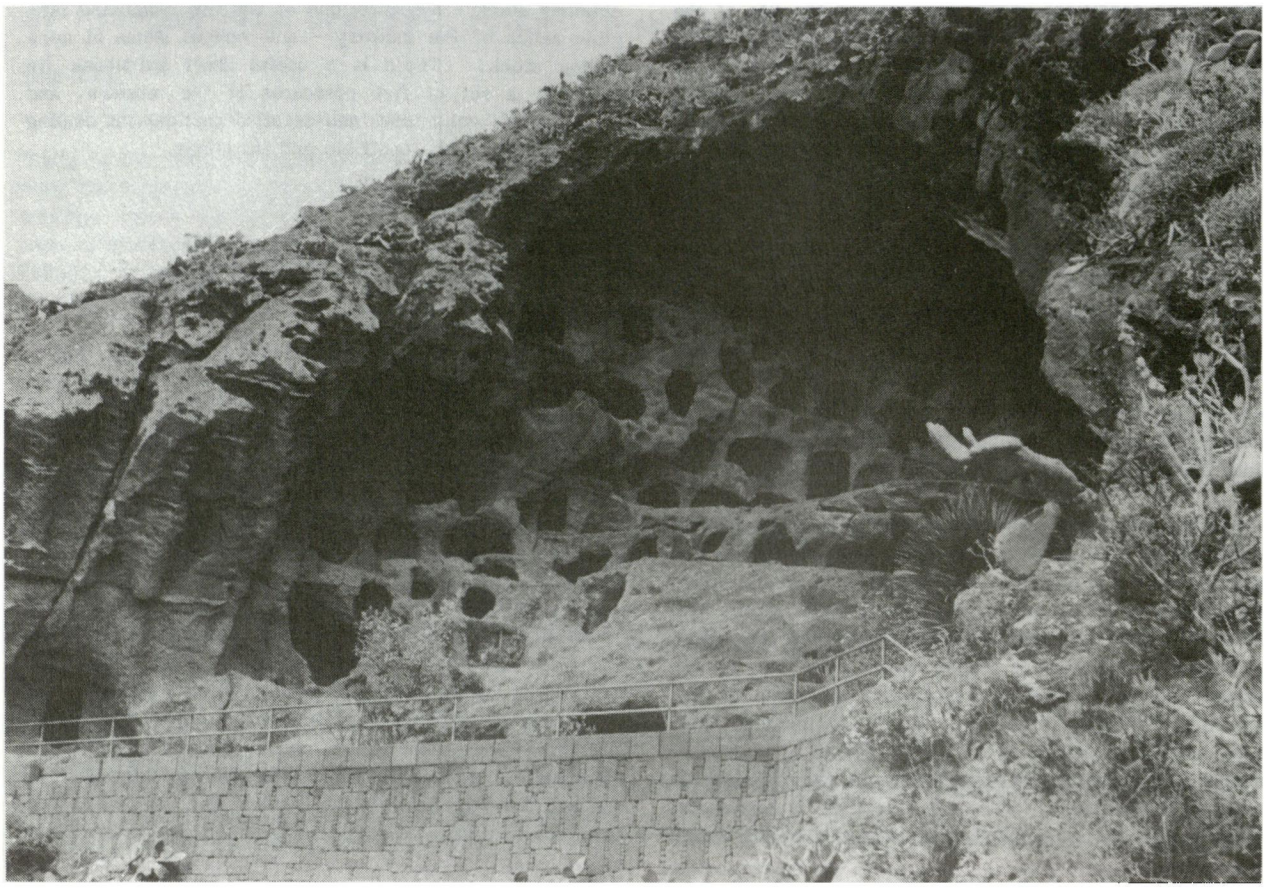


Figure 2. Cenobio de Valeron - honeycomb of caves, Gran Canaria (photograph by Alan J. Beamon, 1987)

made of skins and grasses sewn together. A single Supreme Deity was worshipped, to whom they made offerings of goats' milk. Their society had no knowledge of other inhabitants on the other islands in the group. They did have a flourishing class system with kings, chiefs, princely families and nobles plus, of course, the ordinary people. Described as a gentle and hospitable people, yet trained in the arts of war, they were, for the most part, cave-dwellers.

Before reaching Guia, just above the road on the Cuesta de Silva zone of the Galdar (north) coast, there is one of the most interesting places of the ancient Guanches, the Cenobio de Valeron. This is a collection of excavated caves, resembling a crude honeycomb, which are dug out of the soft yellow lava rock-face under a great overhang. I would like to propose that the expression "resembling a crude honeycomb" may not be too far from the truth, not for bees but for women prior to their wedding nuptials. It is claimed by some that these caves or cells were once used by the *Harimaguadas* - the Guanche equivalent of the Roman Vestal Virgins. Mercer (1980) argues that these chambers, some 200 of them, were used as a common granary (known only to Gran Canaria in the Canary Islands). Holding grain inside, the front of each small silo would have been plastered over with mud, and this whilst wet impressed with the owner's distinctive personal seal: one such seal being found at Cenobio giving credence to the theory. Also to be noted is that similar artefacts have been compared with those of Berber tribes in Morocco and Algeria. However, there is no reason why the site could not have had more than one function, even at the same period of time.

We find that in Gran Canaria it was customary to fatten a girl for 30 days before marriage - as the Moors did or still do. What better place than close to the tribe's main granary? Hernandez (1952b) said that marriages on this island gave occasion to public feasts lasting 15 days. It was also obligatory that the bride's family had to fatten her up to be socially correct, putting her apart for the 30 days and 'stuffing' her with milk and gofio (a flour ground up from toasted grain - barley, wheat, amangante, or even from fern roots). It was supposed to enlarge the womb and thus aid child-bearing.

Azurara (1443) wrote that the bride-fattened women became so bloated that "their skins are wrinkled like ripe figs", and that the nobles had a right to the first night: the fattened maidens paraded naked before these gentlemen, those who were judged to be too fat having to go into the sea and swim it off. Only after having lain with the nobles did the women go to their new husbands. Bernaldez (1479) said the women had the right to choose amongst the nobles. Mercer (1980) maintained that no justification has been noted for the Gran Canaria nobles first night with the virgins on the eve of marriage, yet they may have had the right to choose amongst them. I think what Mercer was saying was that, anthropologically speaking, there was no justification for the specific singling out of the nobles for this rite.

There are some questions to be aired.

Was it necessary for women to be fattened-up before marriage? If so, what was the cause? Social? Physical?

Socially, in many societies rounded women are considered to be much more attractive than their stick-like sisters. For a society who live with economic poverty, where famine is always a possibility, where every meal has to be worked for assiduously and continuously, fatness is a state to be desired and admired, a sign of wealth and power, of leisure, security and contentment. This applies particularly to the womenfolk of those in power, in fact, the wives of royals are expected to be fat. No self-respecting man would wish to take a skinny bride for himself.

I want to show that, from a physical point of view, it may have had a more fundamental reason where deprivation in terms of food caused by drought etc. could have altered the young womens' ability to menstruate, hence infertility and no babies.

That weight, and the possibility of body fat, is an important factor in menstruation is demonstrated in the 'modern' disease anorexia nervosa. There is a critical weight a young girl must reach for menarche (onset of periods). Also, when a woman's weight falls below her own critical level, menstruation is likely to stop, and only starts again when that weight has been attained. A cessation of menstruation (Amenorrhoea) can certainly develop as a result of starvation. Not only that, but starving women are likely to develop a dry, mottled and roughened skin, head hair is apt to become thin, dry, brittle and lifeless, or even fall out; and some might even have oedema, mainly in their legs. Sexual interest is more than likely to be absent: this in particular is hardly a good omen for marriage.

The climate in Gran Canaria is capricious, the N of the island being more verdant, but Cenobio lies more centrally, where it is considerably more arid. Rainfall in some years is limited, which in turn probably led to lean years as regards arable crops. Droughts are recorded and the Guanches held "rain" ceremonies, which speaks for itself.

At the turn of this century, in Great Britain, the recommended treatment for women suffering from anorexia nervosa was seclusion, rest, massage and frequent large meals when a steady weight gain of 2lb a week was expected. It is not difficult to see that if the Guanche women were treated likewise, and were "set aside" in the larger of the cells at Cenobio, then weight gain would be the result. They could have been the "queen bees" of their society. If the Guanches were well aware that weight reduction caused menstruation to stop, there is no reason why women of child-bearing years, not necessarily just the brides, could not have spent an extended "holiday" or period of rejuvenation at this site from time to time! And remember, that legend associated Cenobio with women.

Obviously, a lot more research is necessary, but I would like to ask readers to keep this idea in mind when examining other cave-dwellings in traditional famine regions.

Bibliography

DALLY, Peter and GOMEZ, Joan (1979), Anorexia Nervosa: Heinemann, London.

MERCER, John (1980), The Canary Islanders - Their Prehistory, Conquest and Survival: Rex Collins, London.

MASON, John and Anne (1976), The Canary Islands: Batsford, London.

MYHILL, Henry (1968), The Canary Islands: Faber and Faber, London.

YEOWARD, Eileen (1975), Canary Islands: Arthur Stockwell Ltd., Devon.

Postscript

I mentioned my theory to a GP in Ely who suggested I contact Professor of Medicine, Ivor H. Mills at Cambridge University Clinical School, Addenbrookes Hospital. The correspondence details are as follows:

SPB - How soon could menstruation start after amenorrhoea caused by lack of nutrition, as a generalisation? Would the 30 days plus the 15 days of marriage feasting be sufficient to increase the woman's weight to start periods? (based on a 2lb a week gain - approximately a stone).

IHM - My feeling is that the well-known delay in puberty, particularly during the last century in years where nutrition was poor, led to puberty frequently not occurring till 17 years of age. I would think that it was somewhat unlikely that in four to six weeks you could switch a young woman from anovulation to ovulation. My experience of patients with anorexia nervosa is that gaining weight frequently restores libido many months before it restores menstruation. Perhaps the fattening might have a bigger effect on the girls' libido.

SPB - Is there any difference between cereal-eaters and meat-eaters? I would have assumed that women who ate meat would have had a higher iron content together with added protein, which might bring her up quicker to the required weight level.

IHM - ... high protein intake is not nearly as effective in making people gain weight as high cereal intake. This is because protein stimulates metabolic rate more effectively and causes the calories taken in to be mostly metabolised. Ovulation appears to be more closely related to gaining weight than to calorie turnover.

(I would like to acknowledge my thanks to Prof. Mills who agreed that I might quote his remarks).

It so happened that the Secretary sent me a cutting from *The Guardian*, 30 June 1988, written by Dr Saffron Davies, who has kindly given me permission to reproduce her article:

Fat: a fertility issue

Health Watch

Saffron Davies

THERE'S no getting away from it: women are fat creatures. If your bathroom scales tip 60kg, then about 18 of those kilograms are accounted for by body fat. In fact, the average woman is made up of approximately 30 per cent fat compared with a typical figure for men of only 15-20 per cent. The battle against the blubber is the curse of many women. And yet, it looks as though the absolute amount of body fat is an important fertility factor; too little of it and women become infertile.

Now, it was unlikely that Neolithic peoples had much idea about body composition, but they may well have been aware that fat ladies, particularly those well built around the hips, buttocks and breasts, tended to have less difficulty in having children. This would explain why fertility symbols, dating as far back as the Stone Age, were often figurines of women typically endowed with a good coating of fat.

Strangely, this historical linking of fatness and fertility actually makes a lot of biological sense. For a girl to begin and then maintain her normal menstrual cycles throughout her reproductive years, she must have a threshold level of body fat. Excessive dieting, or its more extreme form of anorexia nervosa, can result in a loss of menstrual cycles and reversible infertility. Normal cycles will only start again when an appropriate amount of fat has been accumulated.

This is not simply a question of body weight, because the same loss of fertility happens to athletes undergoing intense training. They may not be thin, nor underweight but they sacrifice their fatty tissues and build up their muscles instead. Menstrual cycles either stop or become very irregular.

A careful study of a female bodybuilder highlighted this phenomenon perfectly. She does not run, jog or dance but concentrates on building up her muscles with exercise machines. When she is in "shape" for a competition her periods stop, despite her rippling muscles and strength. In between times, when exercise is less intense and a few pounds of fat are laid down, her periods resume.

This somewhat obscure dependence of fertility on body fat is a fact which was more or less stumbled upon. Back in the early Seventies, Rose Frisch and her colleague, Roger Revelle, at Harvard University were gathering information about heights, weights and calorie supplies of communities in Asia and Latin America. They were trying to estimate the world's food requirements.

While analysing all the information, they found that the age at which girls had their most rapid growth in weight (an event preceding the first menstruation or menarche) was dependent on a girl's weight rather than age. In other words, girls from communities with poor nutritional standards had a later growth spurt and menarche compared with heavier girls with a good calorie supply.

That, perhaps, was not so surprising but when they found that during the growth spurt most girls more than doubled their body fat (with a much smaller increase in lean mass), they began to suspect that fat may be the vital clue.

After many years of careful study this has proved to be so. Adolescent girls need at least 17 per cent of their body weight in fat before they can start menstruating. Hence, very thin girls, young athletes, dancers and the like, are often quite late in starting their periods.

The same principle applies to adults when ovulatory cycles or menstruation stops because of dieting or intense training. However, in order to get their cycles going again, fat stores must build up to over 20 per cent of their body weight. An extra amount, which would correspond to the further growth that normally takes place between menarche and 18 years of age. At this stage, reproductive functions have usually reached full maturity.

Sometimes, this dependency of fertility on fatness is so finely balanced that a woman need only gain or lose one or two kilograms before her menstrual cycles are switched on or off accordingly. Such dependency does go a long way towards explaining the enormous variations in human fertility seen in populations that do not use any form of contraception.

For example, the hard living nomads of the Kalahari desert produce an average of four children compared with the well-nourished Hitterites in the US (a non-contraceptive religious sect) who average 11.

It may be presumptuous to assume that this difference in the number of offspring is totally related to body fat. However, poorly fed women tend to have prolonged periods of infertility while they are feeding their infants: presumably due to their depleted fat reserves. Not so with women with good fat stores. They can conceive again very soon after the birth of a child, irrespective of whether or not they are breast feeding. Good nutrition keeps their fat levels above the critical point of 20 per cent of their body weight.

So what is so special about fat ? Obviously evolution has endowed women with comparatively large fat stores as a reserve of extra energy for pregnancy and lactation. Part of the survival principle. Yet this does not really explain why women can lose their fertility simply through shedding a few pounds of fat.

The answer seems to lie in the fact that fat tissues store sex hormones. When fatty tissues are at a low ebb they convert their stores of sex hormones into oestrogens with low biological activity. Consequently, low fat reserves are linked with weak oestrogens and low levels of all the other important sex hormones. The ovaries become inactive. On the other hand, plentiful fat stores produce a very active form of oestrogen which can maintain normal fertility. Quite why this should be so is not known

TWO NEW THAMES TUNNELS

Roger Morgan , BSc

When the Brunels, father and son, drove the first ever subaqueous tunnel beneath the Thames in 1825-43, the project was beyond the leading edge of current expertise and became a icon of Victorian technological endeavour against impossible odds. The river broke through the roof and completely flooded the tunnel five times; work was abandoned for seven years with the shield bricked up behind a mirror and the half-completed tunnel open as a tourist attraction (*the Great Bore*); at least 12 men were killed and many more died from cholera caught from the constant rain of river water; the total cost was £486,249 and Sir Mark Isambard Brunel's health was irreparably damaged. But its fame was stupendous, twice as many people visited it in August 1851 than the Great Exhibition, of the same year, and Miss Julia Pardoe, visiting Constantinople, was closely questioned on it by Mustafa Reshid Pasha.

The huge spiral descent ramps were never constructed, and so this herculean project lingered as a seedy footway-cum-funfare connecting Rotherhithe and Wapping until bought by the East London Railway in 1864, never having paid a dividend to its backers.

With this dreadful precedent, subaqueous tunnelling was abandoned as beyond contemporary techniques for 43 years until Barlow/Greathead's shield-driven segmental cast-iron Tower Subway set the pattern for all subsequent London Clay tube tunnels.

One hundred and thirty one years later the Greater London Council's Thames Barrier, seven miles downstream from Brunel's tunnel, was its true successor. One of the largest and most difficult civil engineering projects in Britain, it is the world's largest movable flood barrier and took 4,000 persons eight years to construct at a cost of £500,000,000 - only the Channel Tunnel will surpass it. A little known feature of its construction are a further two sub-Thames tunnels, bringing the saga of the Thames Tunnel full circle.

The Barrier consists of ten movable steel gates spanning a third of a mile [530 m] across the tidal Thames at Silvertown. The four largest gates, each 61 m wide, span the navigable channel. They are sectors of cylinders which can be rotated about a horizontal axis, so that they either lie flat on the river bed in a concrete cill, or rise to form a vertical wall against the tide. Designed to resist all but a 1,000-year tide, the barrier should cope with 50 years of rising average tide levels.

The gates are rotated by a pair of hydraulic rams at each end rocking a massive crank. This machinery is housed in nine piers, 13 stories high with foundations 15 m into the chalk, built within deep water coffer dams. They are linked underwater by pre-constructed cellular concrete cills which were floated to the site and flooded to sink them into position.

All the piers and their machine rooms evidently have to be connected by power and control cables and to allow human access, and by an absolutely fail-safe method, considering that the barrier will be operated for real in virtually disaster conditions.

The solution was to incorporate two completely independent and unconnected tunnels in the concrete cills, each carrying a duplicated cable network. Each tunnel therefore connects both banks, allowing any part of the barrier to be reached, under any conditions, from either end and by two separate routes.

My schematic section, compiled from the various publicity handouts available from the *Barrier Information Centre*, gives an idea of the stupendous scale of the undertaking from the size of the man in one of these tunnels.

LETTER TO THE EDITOR

John E. Vigar , LMIP

Dear Sylvia,

Please allow me to add to the interesting article by Nesta Caiger on the works at Cobham Hall, Kent (Bulletin 24, p. 31).

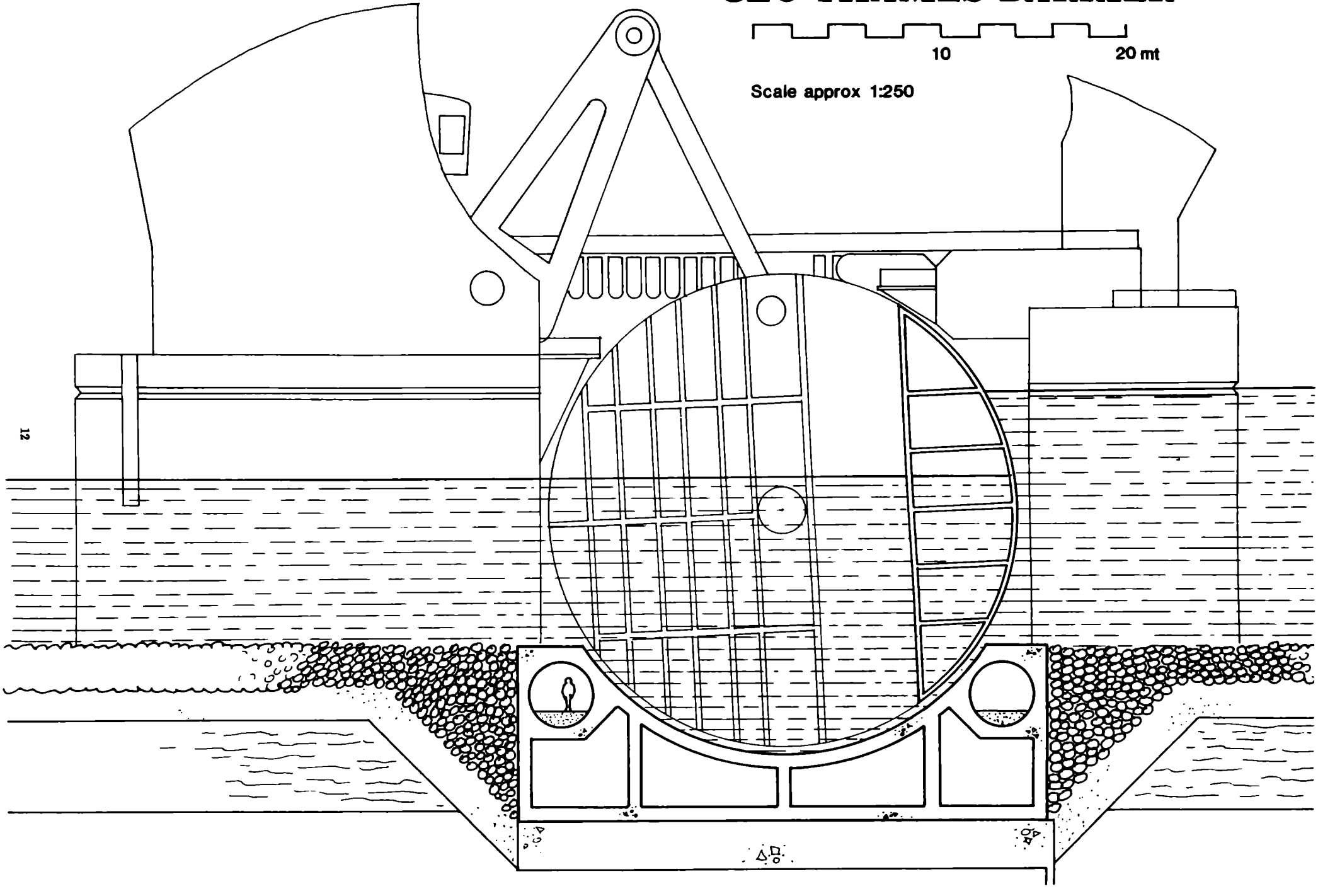
In fact Cobham Hall is privately owned, by the Westwood Educational Trust, who purchased it from the Ministry of Works after extensive restoration work twenty five years ago. Whilst the house itself is in a good state of repair, the gardens and associated buildings require much work to be done, and in 1985 the 'Cobham Hall Heritage Trust' was launched, under the chairmanship of the present Earn of Darnley. They intend to restore the Repton landscape including the buildings, and work has already started. The mausoleum mentioned by Mrs Caiger has been offered for sale by Lord Darnley with outline planning permission to convert into a large residence. It has suffered much decay of recent years and this is the only solution.

Group visits can be arranged to the grounds at any time by contacting Philip Cave-Brown, Dorrington Cottage, The Street, Meopham, Kent. Tel: 0474 813648.

With best wishes
Yours sincerely

(Signed) John
13th June 1988

GLC THAMES BARRIER



CONTRIBUTION TO THE STUDY OF ICE-HOUSES IN GERMANY AND CENTRAL EUROPE

Dorothee KLEINMANN

In the building of ice-houses two major problems had to be considered: insulation and the disposal of the melted water. In the first place, the choice of the site was important: it had to be dry, if possible on the top of a mound planted with trees and leafy bushes or protected by other buildings. The entrance had to be on the northern side. Although every building had to be adapted to the needs of its owner, it can be generally said that a round ice-house, measuring 6 m in diameter, with a cone-shaped bottom met most requirements.

Rectangular pits could measure 4-4.5 m on each side. If the earth was suitable, the underground part was lined with wooden walls which provided better protection from the moisture than did masonry. When that was used it had to be made of a material which was a poor conductor of heat, like volcanic rock, limestone, pumice, etc. Mostly we find walls made with pebbles and building-stones, without mortar or clay because these substances would be eroded by moisture. Moss was used as in the construction of a well. Bricks were unfit for use unless they were particularly well fired or, better still, fired twice.

The ice-pits were 2-7 m deep, mostly funnel-shaped at the bottom. A grate of wooden beams, about 1 m above the ground, served as a platform on which the ice was piled up, the melting water ran off into the pit below, which sometimes contained a water disposal system. When the ice house was located on a mound, a little ditch drained off the water to lower ground. On top of the underground structure, a well-insulated little building often served as a storage place for food.

GERMANY

Investigations made in Germany show that ice-houses were as widespread as in France and probably as in Britain. Examples are not numerous but those that have been found are of all types. Let us first consider castles.

On a map dated 1799, the description of the park of Stockau Castle built from 1685 to 1699 near Dieburg in Hesse (1) shows "the little ice-house" and "the bigger ice-house", both of which were inside the enclosure of the vegetable gardens. These gardens have now become a residential area and nobody remembers where the ice-houses were located.

An ice-house built in 1838 in the park of Furstenau Castle, near Michelstadt/Odenwald, was the subject of the customary fire insurance. The Prince paid 500 fl in construction costs. The building could hold 1.728 m^3 of ice. In 1876 it got a new straw roof (2). Today even its former location is unknown.

This ice-house had been built like another one at Waldleiningen owned by Prince Leiningen on the outskirts of Amorbach in the Odenwald. The Prince possessed another ice-house in the Furstliche Seegarten (garden on the lake). These buildings disappeared but their plans are still kept in the archives (3).

Near Vielbrunn in the Odenwald, in the beginning of the 18th century, the Princes of Lowenstein-Wertheim had built a modest hunting lodge, Hainhaus, close to an ancient Roman castellum of the Limes. Its ramparts were used for the construction of an ice-house for which an artificial hillock provided insulation. A few years ago when the guide showed the site to official visitors we heard him describe the hillock as the foundation of the Roman guard tower belonging to the castellum!

Daren (Oldenburg) ice-house is the model of such a building, in the grounds of one of the many manors which existed in northern Germany and, before 1945, also in central and eastern Germany. The manor, built in 1740, is surrounded by moats. Among the hen-houses stands a little building of timber frame and fired bricks. Half of it is used as a laundry. The other part, which extends to the edge of the moat, covers the ice-pit. On the slope just above the water level, there is a great door through which the ice, cut from the moats, was taken in. This door was well weatherproofed and insulated with sacks of peat. In summertime the ice was taken from inside the building through the top. The ice-house was used in this manner at least until 1946 when an eye-witness saw workers piling up the ice.

A good example of a private ice-house in town is that of the old Riedesel Palace (Merck'sche Villa) at Darmstadt. It was rectangular, 3 x 4 m, and 2.50 m deep. The masonry was constructed of good yellow volcanic stone from Vesuvius. Out of service, forgotten in a shadowy corner of the park, it was re-discovered in 1945 following the destruction caused by an air-raid. The owners thought it might be an old Germanic sanctuary.

Some food industries, especially breweries, used ice-vaults built, generally speaking, like the Paris Bastille's underground compartments. Social institutions like hospitals or sanatoriums had their own ice-making facilities, as for the example of Illenau, a mental hospital at Achern (Black Forest) shows. Near the buildings a little river, the Muhlbach, passes between dykes. In autumn, water was drained by a channel to fill up three of four nearby shallow basins with a surface area of 50 x 50 m. When frozen, the ice would be cut weekly and transported to the typically shaped ice-house, 1 km away under an artificial earthen hillock planted with trees. The children of Achern liked skating on the ice basins, which were still used after World War II, and it was one of them who gave the writer the information (oral reference, Mrs G. Roggenbuck, December 1980).

As in the case of the La Glaciere district in Paris, the German municipalities supplied the inhabitants with ice. In the porphyry rock along the riverside at Halle on Saale (RDA), a huge natural grotto probably inhabited since prehistoric times, situated between the Rainstrasse and the Felsenstrasse, had been used as an ice storage pit.

The author's correspondent remembers that it was used until 1914.

At Greiffswald in Pomerania a magistrate had a new ice-house built in 1846 in the ramparts of the town, with an entrance on the northern side (4). The melting water ran off into the light soil of the rampart; so he was spared the necessity of building a water disposal system and conduit. The foundations, built with pebbles, measured 4.5 m^2 and were set 3 m deep in the ground, covered with a layer of 1 m of peat. Over this the ice was piled up on a solid grate of timber bars to a height of 2 m. This ice pit was covered by a wooden building 1.8 m above the ground. It was used for food storage.

Elsewhere private individuals used the ancient ramparts. At Wittenberg on Elbe (RDA) they were destroyed in 1873 and the moats drained off to several large ponds. All around the old town some rampart remains were still preserved and became the property of the people who lived there. Often they built ice-pits in them which they filled up in winter time with the ice from the ponds. Old galleries in the fortress were used for the same purpose even after 1918 when Wittenberg ceased to be a garrison town and there was no longer any need to store powder and ammunition there.

The municipal ice-house at Wittenberg was near the ancient Elbtor (gate). It has a rectangular pit built of beams, 9 m long, 7 m wide and 2.5 m deep below the street level. Above it, a building 5.5 m high, rising over the pit, was surmounted by a terrace. The ice was cut in the Elbe River and each layer was covered with sawdust for insulation. Used as an ice-house until 1925, this building became the warehouse of a decorator.

CENTRAL EUROPE

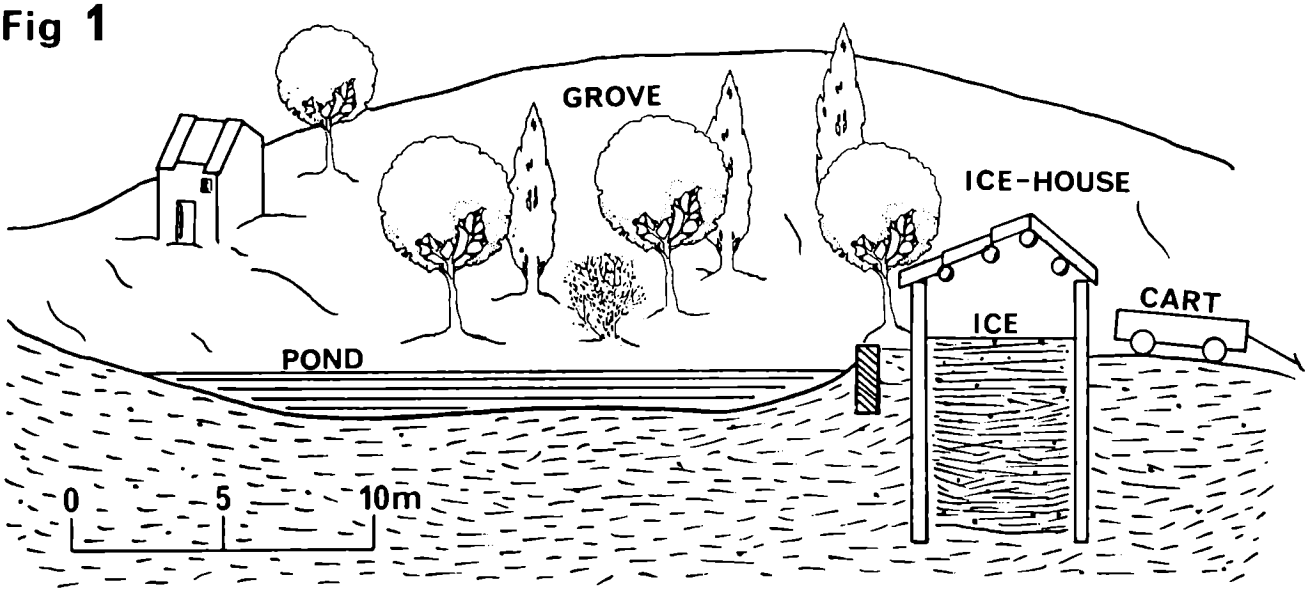
Turning now to the colder eastern countries of the continent, which nevertheless were loath to abandon the luxury of cooking in kitchens supplied with ice during the short hot continental summers. Random correspondence tells us about ice-houses of traditional design here and there in Poland and in present-day Russia in the former German manors or large farmhouses. One example was given to the writer by the former owner of a villa on the seaside in Estonia, between Reval and Narva. The terrain is formed of combustible layered stratified rock (shale) at some places extending below sea level. All along the coast, some 100 to 200 m from the shore, villas followed one another. Almost everyone had an ice-house built into the schist and covered by a roof of shingles going down to the ground. The underground walls were insulated by cut straw. These ice-houses under their protecting trees were one of the pillars of the Baltic gastronomy which is now nothing but a memory, like the ice-houses of former times all over Europe.

In the Warsaw district of Poland there were cellars some 10 m long by 2 m wide, excavated in the ground. The blocks of ice gathered in February were piled up in the pits, covered with cut straw, then long straw and finally with earth on the surface. This stored ice remained until the next winter. This practice was generally used before 1939 and continued during the war and even later.

ITALY

Finally consideration should be made of a country where the oldest examples come from the Roman period. The Romans cut ice in the Alps and transported it to the towns

Fig 1



After D Kleinmann

Figure 1. An ice-pit in the Lessini region (Venetia, Italy), with its pond (pozza), the grove giving its shade (boschetto), the ice-house (ghiacciaia) containing the ice (ghiaccio) and the special cart (carretta) for the transport of the ice to the valley. (After E. Turri, "Un attivita scomparsa sui Lessini: la produzione e il commercio del ghiaccio", Atti e Mem. della Acad. di Agricol., Sc.e Lett. di Verona, 1971-2, vol. XXIII, p. 411-422.

even though they were far away. From the Monte Rosa and the Selva di Tarnovo in the eastern Alps the trade spread as far west as Alessandria, north of Genoa.

The first modern documents about ice production in Italy date back to the 15th century. In the Middle Ages, the natural hollows in the Karst Mountains were used to store snow. From the 16th and 17th centuries onwards the ice trade was well established. At Mantua people collected the ice in special little conduits and stored it in underground ice-pits in the shadow of poplar trees. These techniques are said to have been introduced in the Veronese Mountains probably in the 15th century by shepherds passing by during their yearly migrations down to the open country in the direction of Lake Garda and the Brenta. In Frioul a winter-ice industry had developed early and when a part of the population emigrated to the Lessini Mountains in the 17th century, ice storage, practised on a small scale, got a stimulus and became an activity beyond anything which Italy had known before.

Henceforth the region of the Lessini Mountains was characterized by these typical installations. They consisted of an oval basin (*pozza*) in a hollow at the foot of a slope shaded by trees on its southern side. The surface of the *pozza* was some 200 m^2 wide, the depth not over 1 m. These basins were filled up by the autumn rains, collected by little drainage ditches. When the ice was 10-15 cm thick, it was cut in blocks 0.80 x 0.80 m square, and weighing 100 kg. In a place where the shore of the *pozza* was accessible by carts, the ice-house (*giasara*) was built. It was made of limestone like the other houses in this region, 1-2 m high and protected by a roof of stone slabs. Under it was a round pit, 10-15 m deep with a diameter of 8-10 m, lined with stone. The round shape was the most efficient because the space between the square ice blocks and the heat-conducting walls assured good insulation just as did the layers of straw and leaves. The capacity of a *giasara* could be as much as 600 m^3.

When the harvest was abundant - a good season allowed seven to eight of them - the surplus production was stocked beside in *bogonare*, a kind of standby silo, where the ice was superficially covered whilst awaiting the summer demand. The *giasare* were provided with two skylights, one on the *pozza* side, the other on the road side, through which the pit was filled and emptied by a winch. From June onwards special carts (*carete*) loaded with 20-30 hundredweights (200-300 kg) of ice, covered with sacks, departed every night for the large towns like Venice, Rovigo and Verona.

The requirements of the rich patricians of Venice from the 16th century on created this trade. It flourished especially in the 18th century and reached its apogee at the time of Napoleon when road-making made transportation to the open country easier. In the 19th century it diminished, and it disappeared completely after World War II.

For many generations ice was thus the main resource of whole communities of poor mountain people. The ruins of the *giasare* and of the *pozze*, which disappeared more and more under the mud as well as in the remembrances of the last ageing inhabitants, are all that remains today (5).

SHORT BIBLIOGRAPHY

(1) DIEL, Karl, (1941), *Ein Parkvorbild der Goethezeit*, Darmstadt, 16.

(2) REITZ, H. (1975), "Die Erbauung eines Eisbehalters im Furstenauer Hofgarten, *Der Odenwald, Zeitschr. des Breubergbundes*, Juni, Heft 2, p. 64-65.

(3) REITZ, op. cit.

(4) MENZEL, Carl August (1848), "Der Bau des Eis-Kellers sowohl in wie uber der Erde, vermittelst Torf, Stroh oder Rohr und das Aufbewahren des Eises in dem selben", Halle, 46 p.

(5) TURRI, Eugenio (1971-72), "Un attivita acomparsa sui Lessini: la produzionde e il commercio del ghiaccio". In: *Atti e Memorie della Accademia di Agricoltura, Scienze e Lettere di Verona*, anno acad., serie VI, vol. XXIII, p. 411-422.

KLEINMANN, D. (1976), "Die Eishauser, eigenartige Souterrains". Roding, *Der Erdstall* Hefte des Arbeitskreises fur Erdstallforschung 2, p. 62-69.

CONTRIBUTION TO THE STUDY OF ICE-HOUSES IN FRANCE

Prof. Raymond MAUNY

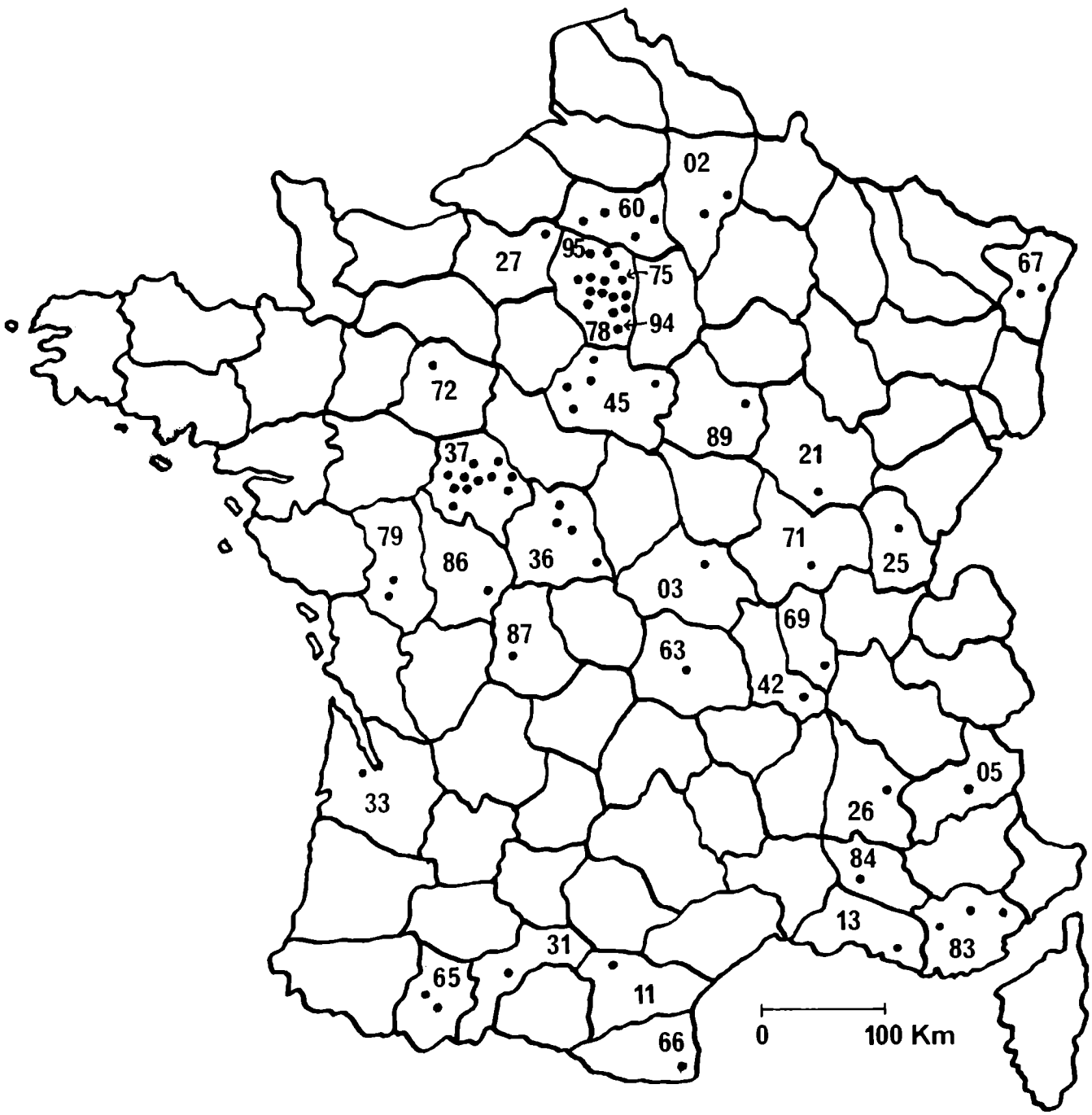
This study does not pretend to give a complete picture of ice-houses in France, for we are only in the early stages of an inquiry begun in 1975 when public attention was focused on these underground buildings at a symposium held in Bergerac (Dordogne) by the British, German and French societies working on man-made subterranean structures.

Papers were then published, showing that ice-houses and pits were known practically everywhere in Europe and the Middle East (Sassanid Persia). A public appeal published in the well known French Review (*Archeologia* No 93, April 1976), which had already devoted its *Document Archeologia* 1973-2 to mediaeval souterrains in general, resulted in many replies relative to ice-houses and pits.

Our British and German colleagues did the same "ice-house hunt" so that we can compare our findings and thus have a better approach to the whole problem. Nonetheless, we are all perfectly aware that much more remains to be found...

Fig 3

France



After R Mauny

If our Societies appear to have undertaken a study which seems a bit far from their major field, that of souterrains, the reason is that when looking for familiar structures, we were sometimes confronted with others (deneholes, ovoid fossae, silos), which we could not identify. When we came across our first ice-houses and pits, the matter was easier for in many cases people knew what they were and, even if three quarters of a century had passed since the greater part of them were no longer used, the name remained, and the location was still known. We even sometimes have the testimony of those who, when young, worked to cut the ice from the frozen ponds, filled up the ice-houses, and carried the ice from the mountain ice-pits to the towns down in the plain.

Introduction into France

When and from where did the use of ice-houses and pits come to France? We have no precise data so far. As the Romans had already stored ice and snow in the mountains to use during summer to cool drinks (Pliny, *Nat. Hist.* XIX, 4), we presume the practice was in use throughout the Roman Empire in countries cold enough to produce ice or snow in winter and hot enough in summer to have a ready market for those who felt the need to keep their food and drink cool.

The only reference I could find - and it has to confirmed - is the possible presence of an ice-house at the Gallo-Roman villa of Montmaurin (Haute-Garonne) near the Pyrenees (1). Large and rich Roman towns like Lyons, Vienne, Aix-en-Provence, Marseilles, etc., most probably got their ice supply from the nearby Alps. As for the Middle Ages, C. Enlart (2) gives us this information: "The nobility of the Middle Ages, which treasured the pleasures of the table, did not fail to stock ice for summer. The castles' basements had ice-pits, as for example in the Pope's palace in Avignon". Pierrefonds castle's ice-house has been preserved and it looks like an underground chamber of the Bastille in Paris which was wrongly identified in 1789 as a dungeon for prisoners (Enlart 1929, p 98).

Research and documentation on mediaeval castles and abbeys would certainly lead to the discovery of other examples, as happened in Vauclair Abbey (Aisne) (3). Many royal, princely, ducal or other rich people's palaces, especially those not too far from mountains, might also have enjoyed the luxury of ice-houses.

As with many other inventions and improvements, 16th century France probably borrowed from what already existed in more refined Italy: more elaborate ice-houses might have been one of them. The first documents on ice production in modern times date back to the 15th century in Italy, and an important trade developed during the 16th and 17th, to fill the needs of rich cities like Venice. Many Italian artists, architects, craftsmen and others followed the French army at the beginning of the 16th century and sophisticated ice-houses might have been one of these improvements found then on the western side of the Alps, replacing the crude techniques used beforehand to store ice, but not only that but to have a ready supply all year long.

We are better informed about the 17th century. Around 1660 Louis XIV built Versailles Castle which was equipped with ice-houses and hot-houses. Rose, King Charles II's gardener, came over to study them and built similar ones in the Royal gardens at Windsor and elsewhere (4). At the end of the century, the use of ice and the ice trade had developed to such an extent in France that a Royal edict signed by Louis XIV in 1701 mentions: "The frequent use of ice introduced into our kingdom a few years ago seems so beneficial for the health that it can be considered practically a necessity, especially in the provinces where the climate is the hottest, a circumstance which led us to grant certain privileges". The same edict mentions that new regulations had to be promulgated because non-authorised persons, acting against the public interest, sold ice at prohibitive prices "in every province in France" and even in Paris.

The 17th-18th centuries' dictionaries and encyclopaedias generally have a chapter devoted to ice-houses - how to built them, how to stock the ice, etc. - an indication of how flourishing the ice trade had become. But that was its golden age, which lasted from the 17th century till circa 1870. Thereafter, ice production declined as costs rose to the point where it was forced out of the market.

The incredible cheapness of ice from American Great Lakes in the 19th century (and later artificial ice) represented such a competitive advantage over the local artisanal production that it brought it to an end. The process was accelerated by World War I and the shortage of cheap manpower that resulted from it. In France, since the 1867 Exhibition, when artificial ice began to be produced, plants were built over widely scattered areas to produce it at cheaper prices than natural ice. After World War I, the 'frigidaires' (refrigerators) came along. They brought the old system to an end.

Specific Functions of Ice-Pits or Ice-Houses

It is difficult to answer the specific question of how they were operated, given the present state of our knowledge of the past centuries. Documents certainly exist but extensive research in libraries and archives would be required.

The principal uses of ice in France before 1914 seem to have been the following:

- domestic use for rich people who needed it to cool drinks and keep meat and food in summer. In farms and modest houses this function was accomplished by meat-safes in cellars which, of course, were not as efficient;
- fisheries and transport of fish;
- transport of perishable goods (fruit, etc.);
- hospital needs;
- breweries, especially in East France (Alsace, etc.);
- butchers;
- pastry-cooks (sherbets, ice-creams).

Distribution in France of Thus-far-Known Ice-Houses (Fig. 3)

Let us warn the reader that at this stage of our research, we do not have a clear idea of distribution patterns: the

figure of 70 we reached corresponds to the answers we received and the literature that came to our knowledge. The real figure might very well be a hundred times more! (there are over 3,000 in Britain - Editor).

The distribution is as follows, the numbers corresponding to each of the 95 metropolitan departments, classified in alphabetical order:

02-AISNE. Vauclair Abbey, 20 km SE of Laon: 13th century ice-house, already mentioned above (see note 3).

Muret et Grouttes Castle, destroyed 1918: ovoid ice-house, built in stone.

03-ALLIER. Nomazy: two 19th century ice-houses built of bricks, filled in and destroyed.

05-HAUTES ALPES. La Roche des Arnauds: artificial lake from which the ice was cut and carried (end of 19th century) by train (Rabot, 1901, p. 1127-1134).

11-AUDE. Pradelles-Cabardès: one of the best examples known at present. The stockage of snow in ice-pits began in 1860. Transformed into ice, it was carried by carts to Carcassonne and other cities for their customers (butchers, pastry-makers, etc.). That industry came to an end between 1915 and 1930, with the competition of artificial ice (P. Castries (1954), *Folklore* No 74, p. 5-8).

13-BOUCHES-DU-RHONE. In Marseilles, where the need of ice was important, the ice came from Ste. Baume mountain (Var).

21-COTE-D'OR. Ice-house at Puligny-Montrachet Castle, South of Beaune: in operation until the end of the 19th century.

25-JURA. Ice-house at Jallerange Castle, 18th century: well preserved.

26-DROME. Lus-La Croix-Haute (1100 m altitude): artificial lakes from where the ice was carried to the cities (Rabot, 1901, p. 1130).

27-EURE. Gisors Castle. 1840 ice-house; access forbidden.

31-HAUTE-GARONNE. Montmaurin: possible ice-house in a Gallo-Roman villa (Eydoux, *La France Antique*, p. 216).

33-GIRONDE. Merignac, in Bordeaux suburbs: place called La Glacière, where ice was stored (brought in from outside or made artificially?).

36-INDRE. Typical ice-houses in Bouges Castle Park and in Villegongis; another in Châteauroux itself (in Château-Raoul, built for Dupin de Francueil, George Sand's grandfather). Another in La Châtre, in the Hôtel de Villaines near the museum, built for the Marquis de Villaines.

37-INDRE & LOIRE. Amboise: typical ice-house, but in bad condition, more or less filled in to prevent accidents, in the part of the Pensionnat Ste Clotilde, La Duparquetterie.

Others: near castles at Coulaine in Beaumont-en-Véron; Beugny; La Brosse at Luzillé; Chezelles (in service till 1914; upper part transformed into a chapel in 1975) (Fig. 2); Tours, drawn on an old map of the castle near the Loire.

St Avertin near Tours: three ice-houses, very well preserved, exist in the castles of Cangé (14th century) (Fig. 1) and l'Ecorcheveau (see Manceau, (1966), p. 279-281, and *Subterranea* No 17, 1976).

Chinon, Tour du Coudray, built 13th century but transformed into an ice-house in 1827, then filled in (20th century), then emptied ca. 1960. All kinds of material had been thrown in it when no longer in use. Two other crude ice-houses existed in Chinon, in the Caves Peintes (filled in to the ground level) and Caves Impasse Jean Macé (Faucillon). The two latter were for the private use of their owners.

Verneuil-sur-Indre, Château de la Gauterie.

42-LOIRE. St Chamond: l'Ollagnière.

45-LOIRET. Chambauboin: the castle's ice-house, dating from 1744, was curiously enough dug just under a pigeon house-tower.

Meung-sur-Loire's mediaeval castle has an ice-house, presented today by the guide as having been poet François Villon's prison (15th century). Of course, it is much more recent.

Other ice-houses existed at Chevilly, near Cosiole Castle, dug in a mediaeval mound; at Chécy, La Bretauche, in bad condition; people did not want to go down into it, saying that ammunition had been thrown in it in 1940; Patay, Lignerolles, in the park of the ancient castle (dead sheep were buried in it in 1960); Montargis Castle's ice-house was destroyed when the ground was levelled for building a road. The last ice-house to be used seems to be Boigny's, which delivered ice to Orleans breweries at the beginning of the 20th century.

60-OISE. Chantilly's Castle ice-house is still marked by a big mound; others existed in Alaincourt, near the castle; Mortefontaine in an 18th century castle park; Pierrefonds Castle's ice-house, quoted by Enlart, 1929, II, 1, p. 98-99.

63-PUY-DE-DOME. Aydat: natural cavity in volcanic rock, where ice accumulated and was cut to be carried to Clermont-Ferrand's Hôtel-Dieu Hospital during the 18th century.

65-HAUTES-PYRENEES. Natural cavities in the limestone of the "Little Pyrenées" and in St Pé Mountains near Lourdes served the same function. The ice was taken from there to meet the needs of cities like Tarbes.

66-PYRENEES ORIENTALES. Albères hills: the snow was stored in "pou de neu" (snow pits), gathered by night and covered with straw and earth. When needed, the ice was carried by night to the towns down the valley. The same existed in Spanish Catalonia.

67-BAS-RHIN. Mutzig: to serve the needs of the breweries, water was flooded into the nearby meadows, where ice was gathered.

Strasbourg: part of the galleries built by Vauban in the fortress was later transformed into ice-houses.

69-RHONE. Grigny: ice-house near the old castle.

71-SAONE ET LOIRE. Cluny-Taise: ancient ice-house.

72-SARTHE. Tucé-Lavardin: an ice-house is depicted on a late 18th century map of the village, place des Halles.

75-PARIS. Place called La Glacière in the 13th district: during the 18th century water was flooded into the nearby Bievre Valley and the ice formed from it was stocked in deep cisterns. It was forbidden by a Royal ordinance to sell it before 1st June.

Other ice-houses existed in the Bois de Boulogne and at Vincennes, built in 1859. At that time Paris needed 6,000,000 kgs of ice per year. The city leased to private societies the right to extract ice from these park ponds for Fr34,000 a year.

Bastille Castle had an ice-house before 1789, as has been mentioned before.

In 1901 the largest ice-storage place in Paris was the Stock-Exchange (Bourse) caves.

78-YVELINES. Versailles: an ice-house was built there ca.1660 as we have already mentioned above. Nobody seems to know its location nowadays. Other ice-houses are mentioned in Trianon Palace and Marly-le-Roy.

79-DEUX-SEVRES. Niort: two ice-houses were found during construction work at the Prefecture. Another big one existed at Surimeau near the River Sèvre.

83-VAR. Draguignan: an ice-house existed near the city at the end of the 19th century.

Important ice-pits are mentioned (even on recent maps, "Puchs Glacières" in the Ste Baume Mountain). The ice was carried from there to Marseilles.

Another is mentioned in the mountain some 20 km NW of Draguignan: "Col de la Glaciere".

84-VAUCLUSE. Avignon: ice-house (no date given, but probably mediaeval) in the Palace of the Popes (Enlart, II, 1, p. 98-99).

86-VIENNE. Queaux, 20 km S of Montmorillon: ice-house in La Messelière Castle.

87-HAUTE-VIENNE. Rochechouart Castle: the ice-house's timberwork was sold during the Revolution.

89-YONNE. Tonnerre: Vieux Chambourdon, 19th century ice-house, the ice being used for hospitals and to preserve food.

Chenay: another ice-house.

92-HAUTS-DE-SEINE. Sèvres, Brimborion: this ice-house is probably 18th century for it is near the 1750 former Brimborion Castle.

Meudon Castle ice-house.

93-SEINE ST DENIS. Drancy, La Motte: well preserved ice-house.

94-VAL DE MARNE. Several ice-houses have been identified: Boissy St Léger, Le Piple; Chennevières, La Maillarde (castle); Lésigny; Santeny; Servan; Sucy-en-Brie, Montaleau and Le Grand Val Castles; Ormesson-sur-Marne, castle; La Queue-en-Brie, Les Marmousets Castle. Many of these castles date from the 16th century but their ice-houses are probably more recent.

95-VAL D'OISE. Mery Castle and Abbaye de Val at Mériel: ice-houses.

Thus some 70 ice-pits and ice-houses have already been identified in France but, as seen above, hundreds of others existed practically everywhere in the country from the 17th century to 1914. In the examples given, we see that the majority are related to castles, manors, abbeys or rich residences, many having nearby lakes, ponds or artificial water reservoirs from which the ice was gathered during the winter. In Southern France, as in Spain and Italy, the snow was gathered and stored in special pits in the mountains and carried from there, sometimes for long distances, to the towns.

This can be considered only as the beginning of our "Ice-house hunt" and is now the right time to gather information about them, for the last witnesses are going one by one...

CASE STUDIES : CANGE AND CHEZELLES.

For Touraine (Indre et Loire) we have two good examples, the first (Cangé) already published, and I personally know the second (Chézelles).

Cangé Castle. Two successive ice-houses were dug in the limestone, some 10 m under the surface, in a 25 m long cave with numerous pillars to support the ceiling. The first, the older one, is only hewn in the crude rock and is a cylinder 5 m in diameter. The second is probably more recent and elaborate and must date from the first half of the 19th century when Count de Richemont, then Count de Pourtalès, were the landlords of the castle.

First a 5 m cylindrical hole was dug in the rock and then an ovoid construction was built in it, 6 m high and 5 m in diameter, in perfectly regular brickwork. A lateral entrance near the top led to a crown of limestone under which 4 m of ice were stocked. At the bottom of the ovoid, a grate allowed the melted water to drain outside.

The author, J. Manceau, got information from several old people who were, when young, Count de Pourtales' servants. In 1900 the castle was in its full splendour and some 60 persons worked there. When the great pond froze, the ice was broken with heavy wooden mallets, loaded on tumbrels and carried to the ice-house. The ice could last a long time when the insulation was good, as in the brick one, but we do not know exactly how long (5).

Chezelles Castle. This is a 19th century castle, replacing a mediaeval one. The ice-house is just S of it. It was built at the same time as the castle, and remained in service till 1914.

It is composed of two parts: opening to the N a small low square room, some 3 m wide, built in local limestone (*tuffeau*) covered with old flat tiles. It was entered by a descent of five steps. A small window opens on the E and a second door leads to the ice-house itself, which is built under a small mound protected from the sun by trees. The ice was dropped down into the ice-house through a hole in the ceiling. The hole was then closed by a flat stone and some 1.50 m of rye straw was piled up on top of it to give it additional protection.

The ice-house itself was hemispherical at its top, to a depth of 2 m to the beamed floor where men could work, then cylindrical to the bottom to a depth of 3-4 m. The wall was built with care in limestone. At the bottom was certainly a grate for melt water.

The ice came from a nearby pond just downstream from the River Bourouse bridge. The landlord's farmers were

Fig 1 Ice-house at Cangé Castle (Indre & Loire)

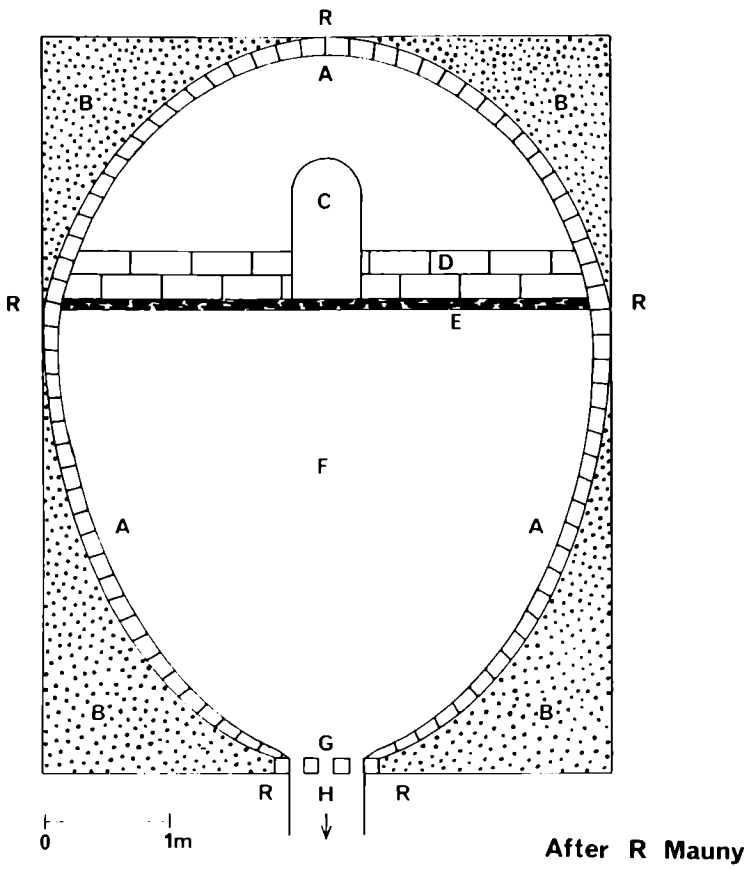


Figure 1. Cange Ice-house

A Brick, egg-shaped walling
B Filling (rock, earth etc.) between the cylindrical cave hewn in the rock and the brick wall
C Entrance door
D Freestone crown
E Floor level
F Ice reservoir
G Grate
H Melted water outlet
R Rock (after J. Manceau, 1966, p. 469)

Fig 2

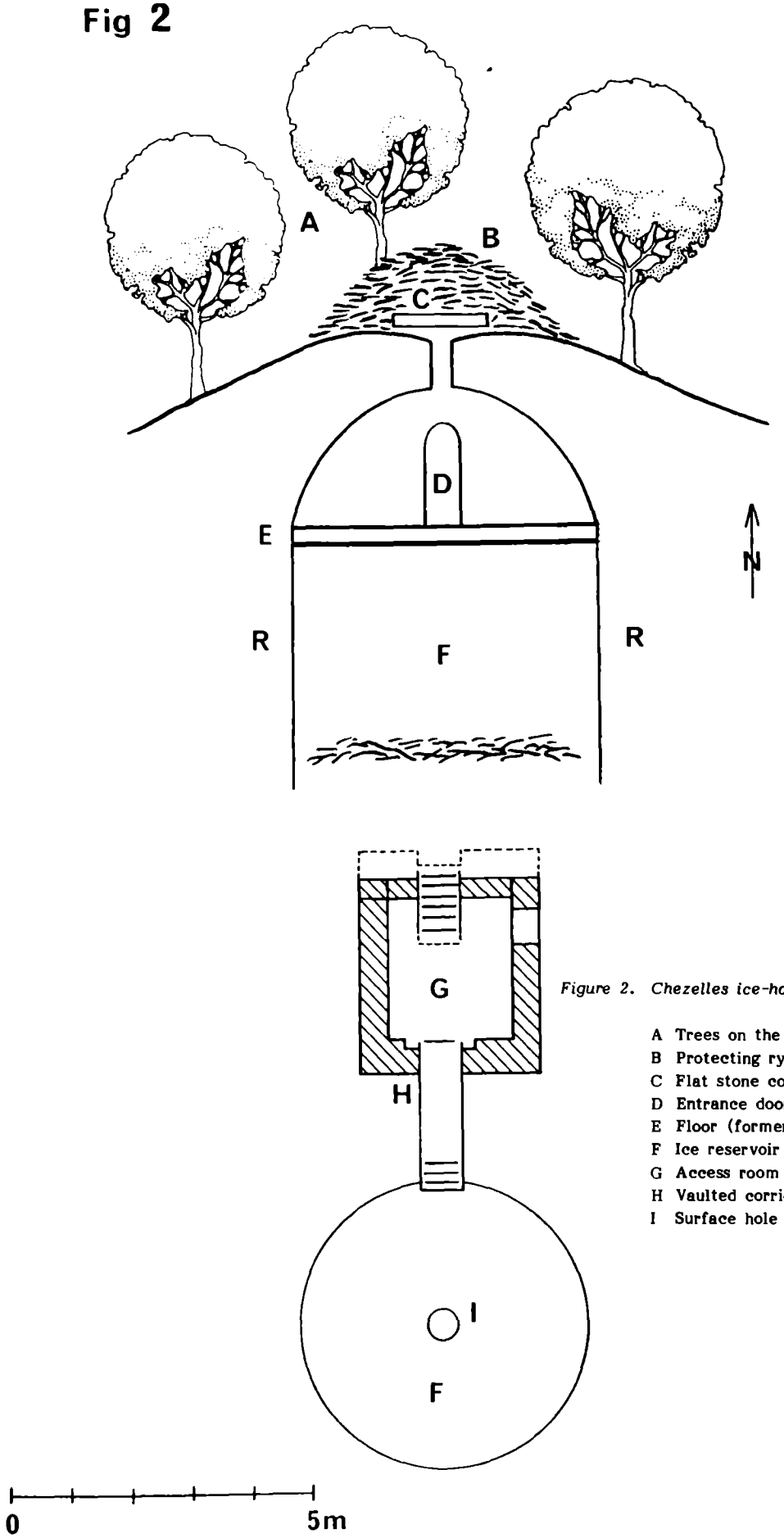


Figure 2. Chezelles ice-house

A Trees on the mound (for shade)
B Protecting rye straw
C Flat stone covering the filler stone
D Entrance door
E Floor (formerly beams)
F Ice reservoir
G Access room
H Vaulted corridor
I Surface hole for putting in the ice

After R Mauny

Ice-house at CHEZELLES CASTLE

(Indre & Loire)

requested, for one or two days during the winter, to cut and carry it with oxen and horse-driven tumbrels to the ice-house. This was considered more of a pleasure than a burden in those days, for the farmers were invited afterwards to the castle for a copious meal.

The ice lasted from one winter to the next. It was used in summer to provide fresh drinks and also for sick people who came and fetched it from there. After 1914, when the ice-houses ceased to be filled for lack of men, all mobilised, ice had to be obtained from Parçay-sur-Vienne Dairy, some 6 km away.

Known Subsequent Use of Ice-Houses

Normally the 19th century ice-houses, which are no longer in use, represented a danger especially for children, who if they fell into them without anybody knowing where they were, could not get out. The same happened to domestic or wild animals. So that most of these structures were filled in with earth, garbage, dead animals etc. or locked to prevent accidents. In other cases, they were only abandoned as they were.

Unique to my knowledge is the transformation in 1975 of Chézelles ice-house, by the Montfortain monks who now inhabit the castle, into an underground chapel devoted to Our Lady (Notre Dame Sous Terre), where young seminarists who retreat there come to pray. Of course, the lower cylindrical part was filled in and only the upper part, over the beam floor, is used.

SHORT BIBLIOGRAPHY

BEAMON, S. (1977), "Ice-houses of Great Britain", *Subterranea Britannica Bulletin* No 5, p. 8-10.

CASTRES, P. (1954), "L'industrie de la glace à Pradelles-Cabardès (Aude). Carcassonne, *Folklore*, No 74, p. 5-8.

DIDEROT (1757), *Encyclopédie ou Dictionnaire raisonné des Sciences, des Arts et des Métiers*, Paris, T.7, p. 690-1.

ENLART, C. (1929), *Manuel d'Archéologie Française*, Paris, Picard, 2° Edit., IId Part, T.I, p. 98-9.

MANCEAU, J. (1966), Côte verte et glacières a St Avertin". Tours. *Bull. Soc. Arch. Touraine*, T.34, p. 279-281 and p. 469.

MAUNY, R. and KLEINMANN, D.L. (1976), "Contribution à l'étude des glacières souterraines d'Europe occidentale et centrale". *Subterranea* No 17, p. 3-12.

RABOT, C. (1901), "Le Pôle Nord à volonté. Emploi nouveau de la glace dans le commerce". Paris, *Lectures pour tous*, p. 1127-1137.

References

(1) EYDOUX, *La France antique*, p.216.

(2) ENLART, C., *Manuel d'Archéologie Française*, 2°partie, T.I (2°edit).

(3) SAUTAI-DOSSIN, A., "La céramique de la fin du Moyen Age à Vauclair Caen", *Archeologie médievale*, V, 1975, p. 398. It dates from the XIII century. This ice-house is preserved, 1.70 m high and its diameter is 2.30 m.

(4) BEAMON, S. (1977), "Ice Houses of Great Britain", *Subterranea Britannica Bulletin* No 5, p. 8-10.

(5) MANCEAU, J., 1966, p. 279-280 and fig. p. 469.

MARGATE GROTTO - A CONTROVERSIAL VIEW

Joan Jackson and Bruce Osborne

The authors read with interest the thought provoking article by Ruby Haslam (1) on Margate Grotto Kent and, perplexed by the speculations as to the grotto's history and associations, organised an on-site inspection in May 1987. At the same time the opportunity was taken to inspect the Margate Caves, another underground site a few hundred metres away. Following the inspection of both sites a review of the supporting literature was undertaken, particularly with a view to identifying supportable evidence regarding the grotto's history. Many of the conclusions drawn by previous historians and investigators could not on investigation be substantiated. This underlines the view that the grotto is an enigma. What we have done, therefore, is to consider the key areas of surviving evidence and previously expressed opinion and to assess these in the light of current thinking. This in turn led to us forming our own opinion as to the grotto's history. Let us look at some of the speculations from available literature.

Is it a Temple? Considerable opinion has been expressed by various people indicating that the grotto was a place of worship. Whilst it may be a place for romanticising, there is no evidence to confirm it as a place of worship. Furthermore, it does not have traditional alignments normally associated with places of worship, neither does it have a confirmed altar. A pedestal exists which could have had a variety of everyday uses. This stands at the far end of the main chamber.

Does the symmetry have parallels in other cultures? Initially yes: however to derive firm conclusions about links

between Margate Grotto and other cultures is exceedingly tenuous. Gothic arches do not necessarily indicate that it is Gothic.

In shape does it resemble the Megalithic serpent at Avebury? Whilst it has similarities to the shape of the serpent so also do numerous other structures. For example the entrance to the World War II underground shelter on Epsom Downs is similarly shaped but its relationship to the Avebury serpent is purely coincidental and thus does not have a bearing on the structure's history.

Does the ornamentation imply cultural links with earlier civilisations? One is hard-pressed to identify devices used in the grotto as relating to precise and similar devices associated with a particular culture. If you look long and hard enough you can spot similarities but nothing provides a consistent message; instead one is confronted with a plethora of possibilities which are highly speculative and cannot be confirmed by other supporting evidence.

What is the significance of Roman cement used in the construction of the grotto? The official guide book makes much of the use of Roman cement in the grotto's construction, in common with Dover Castle, and attempts to use this fact to illustrate the antiquity of the grotto. In fact Roman cement was used widely in construction work prior to the 1930s when Portland cement superseded its use. Roman cement was used in the construction of the Martello towers in the early 19th century, a point we shall return to later. A further example of the use of Roman cement is in the engineering work associated with the Bridge of Allan and Aithrey mineral water spa where such cement was used to "lute" the pipes (2). The date of these engineering works was 1827. This Roman cement was used for waterproof bonding during the 19th century and should not be construed as dating the works to the Roman times.

Is the symbolism religious? The fund of religious symbolism to compare the grotto with is inexhaustible. Inevitably there are similarities but no consistent message.

What does the symbolism represent? Depending on one's expectations it is possible to discern links with Tarot cards, zodiac signs, playing cards, celestial constellations, dominoes, and the clover-leaf layout at motorway intersections. Von Danekin would doubless see evidence of extra-terrestials. To the writers the designs more closely echoed Jacobean embroidery.

Do the shells used imply contacts with far away places? No, the shells could and likely did come from Pegwell Bay, which is only a short distance away 'as the crow flies'. This implies local collection, relatively easily conducted.

Was it constructed by the Phoenicians about 2800 BC? No evidence exists to suggest such a link either direct or indirect. The grotto, incidentally, has been markedly devoid of artifacts which could be used to date it prior to 1800.

Was King Alfred involved in its construction? This is a classic example of the tenuous links made by authors. Such links do more to confuse than clarify the grotto's origin. Supposedly King Alfred burnt his cakes; if this was an actual event and not a metaphor (as is more likely) the cakes may have been traditional heart-shaped ones. There are heart-shaped decorations in the grotto, thus supposedly indicating a link. If we accept this type of reasoning, then the grotto has closer associations with modern heart transplant surgery than King Alfred. Clearly the whole thing is nonsense.

Does the Rose Motif have significance? A frequently repeated decoration in the grotto is a representation of a flower generally taken for a rose. In fact it looks rather more like a peony, being wide and flat. It is in any event not the briar rose often used in heraldic representation. Assuming it is a rose, and was not merely repeated because the creator was pleased with the effect, could it have peculiar significance? Roses have many associations including the Labour party symbol in the 1987 election. What further evidence is there to suggest associations with the grotto roses? Very little as far as the Wars of the Roses, the Rosicrucians, and Rose Mystica or many other roses are concerned. The only hard evidence that may be relevant is that the grotto is on land which was once part of the property known as Rose Lodge.

Are the crosses of St George and St Andrew present in the grotto? The devices either side of the Royal Arch could be interpreted as such but could equally be simple geometric shapes with no particular significance.

There are many more aspects of the grotto folklore that do not stand up to scrutiny or endorsement. The guide book is a veritable mine of such speculation but the fact of life is that no-one appears to have come up with a credible conclusion regarding Margate Grotto's history.

In an effort to do so, let us look first of all at known chronological facts noted by Ruby Haslam:

1 **1821** - Site is shown as meadowland on Edmund's map of Margate.

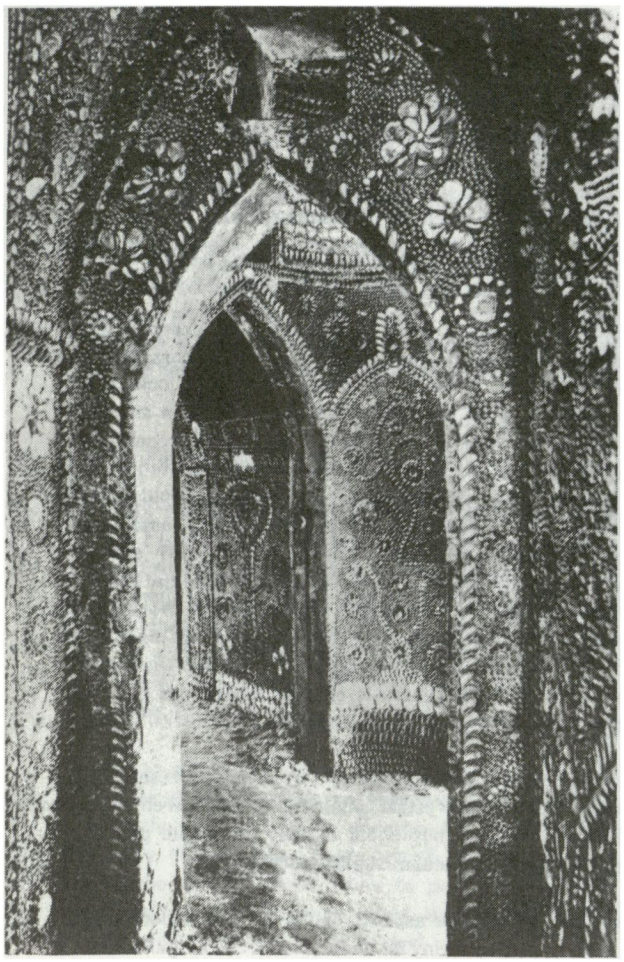
2 **December 1829** - George Bowles, builder, purchased Luke's Dane Field and built a cottage on the site. Later he apparently left for America. Called Belle View Cottage, Mrs Newlove opened a girls' school in the cottage.

3 **1835** - Schoolboys from Dane House School next door discover the grotto.

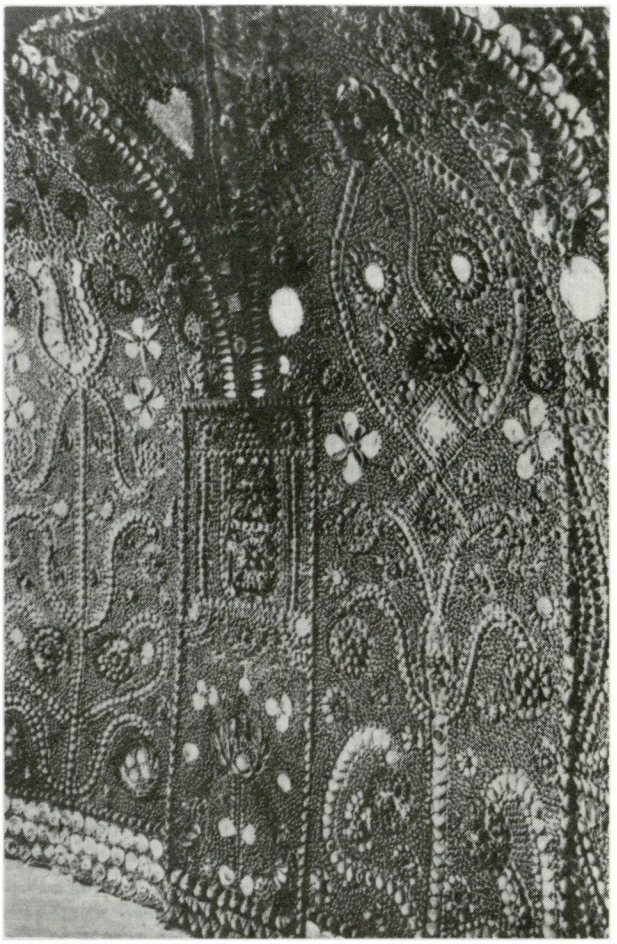
4 **August 1837** - Mr James Newlove purchased the freehold of the cottage to extend school. Cut new entrance passage and opened grotto to the public. Mr Newlove had difficulty in locating landowner - negotiated through agent.

5 **Later** - Mr Newlove modified main chamber as school room by removing vaulted roof and flooring.

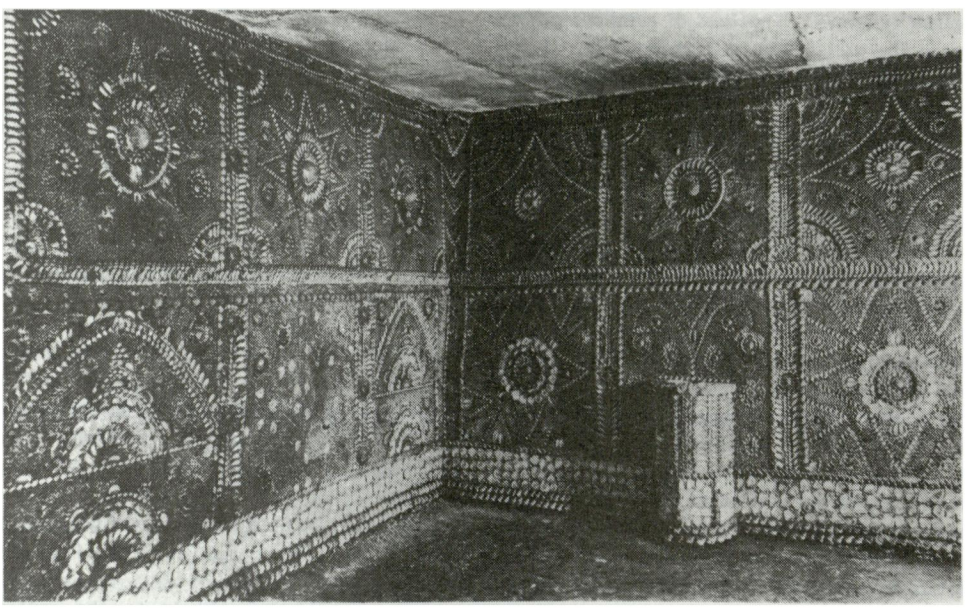
It seems highly unlikely to the writers that the main chamber was ever used as a school room - or a writing room. It is dark, damp and cold. Certainly it would be most unpleasant to sit still in the room - which is also quite small - for long. But James Newlove, proprietor of the Dane House School, clearly had an eye on the commercial



The Margate Grotto - The Dome



The Margate Grotto - The 'Ganesha God' Panel



The Margate Grotto - The east end of the rectangular chamber

possibilities of the grotto when he bought the land, opened the grotto to the public and modified the main chamber reportedly as a school room.

No wonder he was annoyed when Mr Wales, the person employed to decorate Newlove's new entrance passage in 1837, claimed to have made the grotto. Ruby Haslam touches on the real answer in that Wales apparently said the grotto was "recently" made by an artisan who went to America. This would have negated Newlove's commercial aspirations, Newlove having a vested interest in maintaining that the grotto had tremendous history.

George Bowles the builder could thus have been the likely creator of the grotto around 1830. Can this hypothesis be supported by other evidence, however?

1. Bowles was a builder who would have possibly been seeking chalk for building work (especially whiting). He could therefore have started a small mine. There is a major chalk mine within a few yards (Margate Caves) which probably had a secondary use as underground malt kilns[3]. The "dungeons" of the guide book are almost certainly hop kilns.

2. Bowles would have no trouble in transporting shells from Pegwell Bay, particularly if he was building in the vicinity.

3. Bowles would certainly have had the expertise to carry out the work involved in the grotto.

4. Roman cement used in Martello Towers in early 19th century Kent would have been known to Bowles as a waterproof cement necessary for such grotto work.

5. If he went to America he may have sealed up the grotto to prevent vandalism pending his return. He obviously had not intended to sell, hence Newlove's difficulty in contacting the owner. The boys from Newlove School unearthed the grotto accidentally when Mrs Newlove was renting the cottage as a girls' school.

6. Shell-decorated structures have always been popular and many were constructed during the 17th, 18th and 19th centuries.

7. Estimates of two to three years work part-time for the labour required by one person to build the grotto indicate that Bowles certainly had sufficient time to pursue his hobby between 1829 and 1835.

8. The fact that the top of the dome was open to the sky indicates that possibly secondary use may have been considered initially. Was this another underground malt kiln similar to Margate Caves? We doubt it, but it is a thought.

9. Recent, i.e. early 19th century, construction would explain the absence of artifacts of earlier date.

10. The decor is similar to other shell grottos of 18th-19th century origin.

Conclusion

The word grotto derives from the Latin *crypta*, a word meaning a concealed subterranean passage or cavern, and is also the source of our words **crypt** and **cryptic**, meaning intended to be obscure or mysterious. Grottos are romantic whimsical follies that have enchanted their beholders since the earliest times.

Look at the psychology of grotto building and we see that Margate Grotto falls neatly into place. Naomi Miller, in her book *Heavenly Caves*, talks about the magic of the grotto, identifying some of the earliest grottos dating back to the ancient Greeks. These are artificial caves with springs gushing forth richly decorated as places to think and speculate, to wonder and dream, to conjure up lost gods and strange notions. Margate Grotto has been singularly successful in achieving just this since its opening in 1837. The shell work is typical of 18th century grottos, wandering from design to design, incorporating symbolism from many cultures.

The authors are convinced that George Bowles built this grotto about 1830 for the prime purpose of enjoying himself in its creation. The mystery that surrounds it is deliberate, and distinguishes Margate Grotto as a successful grotto. Read the guide books and other literature, indulge yourself in wide speculations as to its origins because in doing so you are fulfilling the intentions of its creator, who set out to make just such an enigma!

References

1 HASLAM, Ruby M. (1987), A Fresh Approach to the Margate Grotto: *Subterranea Britannica Bulletin* No 23, pp. 21-25.

2 FORREST, William Hutton (1831), *Aithrey Mineral Springs*, p. 11.

3 MORGAN, Roger J. (1984), Margate Caves: *Subterranea Britannica Bulletin* No 20, pp. 16-17 (see footnote).

Further Reading

JONES, Barbara (1979), Follies and Grottoes: Constable, London, pp. 172-174.

RECENTLY DISCOVERED SOUTERRAINS IN CO CORK: Part II

R.M. Cleary

The reader is referred back to Subterranea Britannica Bulletin *No 23 (1987) for the introductory discussion on Irish souterrains outlined by Catryn Power in her article* Three Souterrains in the Cork/Waterford region of Ireland, *pp. 16-20. The first part of Rose Cleary's original research work in Co Cork was published in* Subterranea Britannica Bulletin *No 23, pp. 30-32.*

Both authors are research students at the Department of Archaeology, University College, Cork, Ireland.

KNOCKNAGOUL (Fig. 1)

This souterrain[1] was discovered during ploughing in October 1983. It was earth-cut and consisted of at least two chambers. A creepway led from the W end of Chamber 1 but it was not possible to gain access because it was blocked by collapsed material. This creepway may have led to another chamber or to the original entrance. The souterrain was apparently unassociated with any visible earthwork and no monuments are recorded at this location on either the 1st or 2nd editions of the Ordnance Survey 6" maps. A *fulacht fiadh*[2] (an open air cooking place) had also been disturbed during ploughing and was seen as a spread of fire-shattered stones.

Chamber 1

This is roughly rectangular and measures 3.4 m N-S and 1.6 m E-W. It was not possible to estimate the original height. The southern end of the chamber, in the first instance, was formed by a construction shaft but it had collapsed. A blocked creepway, 75 cm wide, led from the W side of the chamber. A second creepway on the E side, 65 cm wide, 62 cm high and 60 cm long (Fig. 1, Section A-B), led into Chamber 2.

Chamber 2

This is rectangular in plan, measuring 3.4 m SW-NE, 1.5 m NW-SE and 1 m high (Fig. 1, Section C-D). The SW end was covered by loose soil and stones which originally may have been part of a construction shaft. The floor was roughly paved and appeared to be protruding bedrock.

Discussion. This souterrain is similar to McCarthy's Type C1 (1983)[3]. If more chambers existed on the W side, where it was not possible to enter during the survey, the souterrain would belong to McCarthy's Type B3.

BENGOUR WEST (Fig. 2)

This site[4] was discovered during the digging of house foundation trenches in December 1983. The souterrain was earth-cut and consisted of five chambers. It was apparently unassociated with any earthwork and the 1st and 2nd editions of the Ordnance Survey 6" maps do not record any monument in the immediate area.

Chamber 1

This chamber is sub-rectangular and measures 3.35 m E-W, 1.5 m N-S and, where best preserved, it is 90 cm high (Fig. 2, Section A-B). Access to the souterrain was gained through this chamber. The E wall of the chamber has virtually collapsed but it appeared to have been formed initially by a construction shaft.

Chamber 2

Situated at a right angle to Chamber 1, this is rectangular and measures 2.1 m N-S, 1.1 m E-W and 1 m high (Fig. 2, Section C-D). A creepway, 90 cm long, 60 cm wide and 60 cm high, led from the E side into Chamber 3 (Fig. 2, Section E-F).

Chamber 3

Sub-rectangular in plan, this chamber measures 2.9 m N-S, 1.3 m E-W and 90 cm high. The N end of the chamber was formed by a construction shaft which was infilled with about five courses of sandstone blocks (Fig. 2, Section G-H). The S end narrows and a creepway leads from here towards the SW. The creepway is blocked with humic soil and it is likely that this was the original entrance shaft to the souterrain. A creepway leads from the W wall of Chamber 3. The passage is angled and has an overall length of 2 m; it is relatively large and measures 80 cm in height and width (Fig. 2, Section K-L).

Chamber 4

This rectangular chamber measures 3.1 m E-W, 1.3 m NE-SW and is 1.1 m high (Fig. 2, Section M-N). A construction shaft with about five courses of sandstone blocks forms the E wall (Fig. 2, Section I-J).

Chamber 5

Opening from the NW side of Chamber 4, the creephole is 90 cm wide. The chamber is sub-rectangular and narrows slightly towards this entrance. It measures 2.2 m NW-SE, 1.25 m SW-NE and is 95 cm high (Fig. 2, Section O-P).

Discussion. This structure belongs to McCarthy's[3] Type C3. The proximity of a spring results in waterlogging of the floors of Chambers 1-3. McCarthy suggests (*op cit*, p 102) that souterrains could have been used as storage areas but in the Bengour West example, this function seems unlikely.

LISNACUNNA (Fig. 3)

This site[5] was discovered whilst ploughing was taking place in March 1984. The souterrain was earth-cut and

Fig 1. Knocknagoul

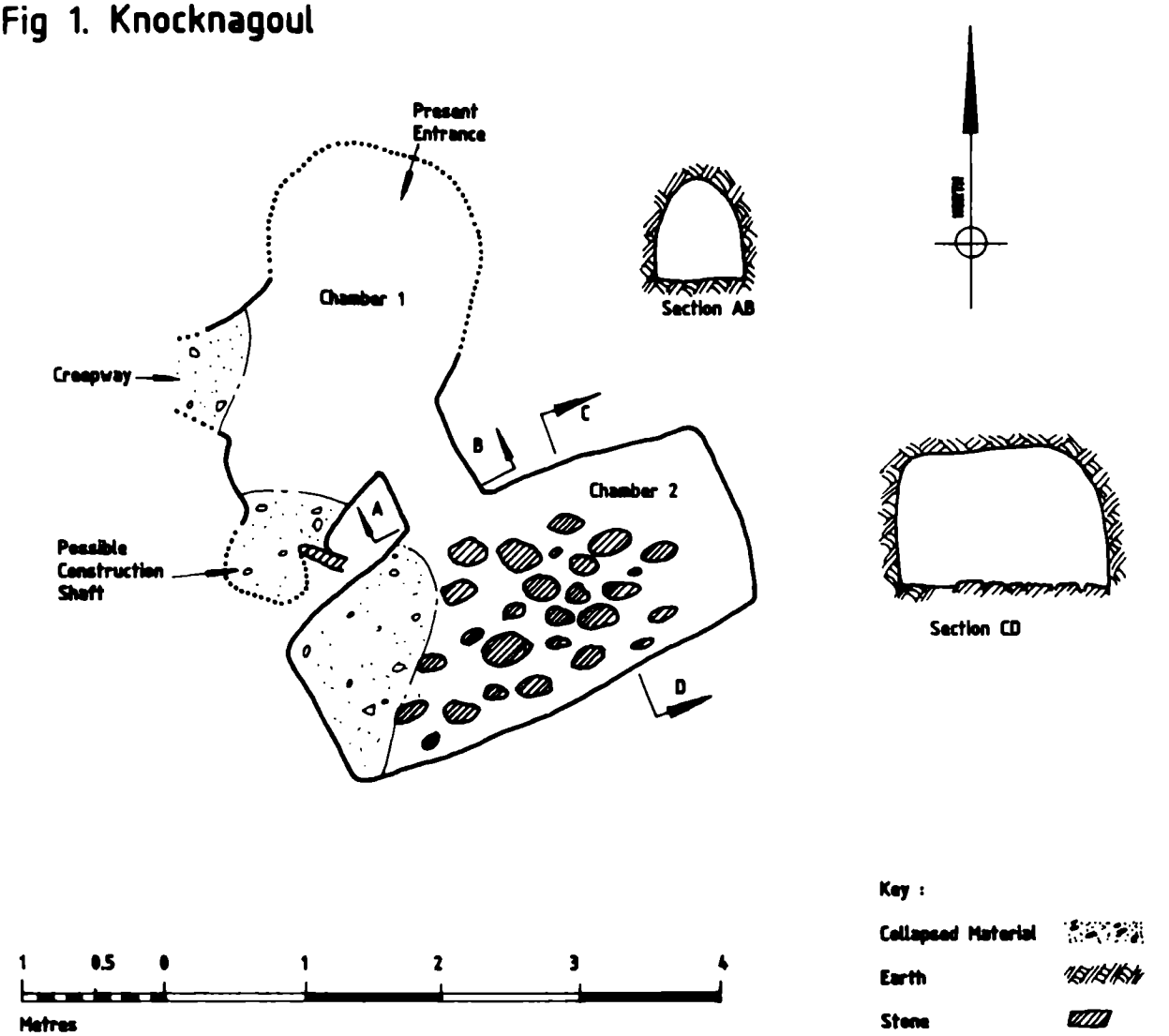
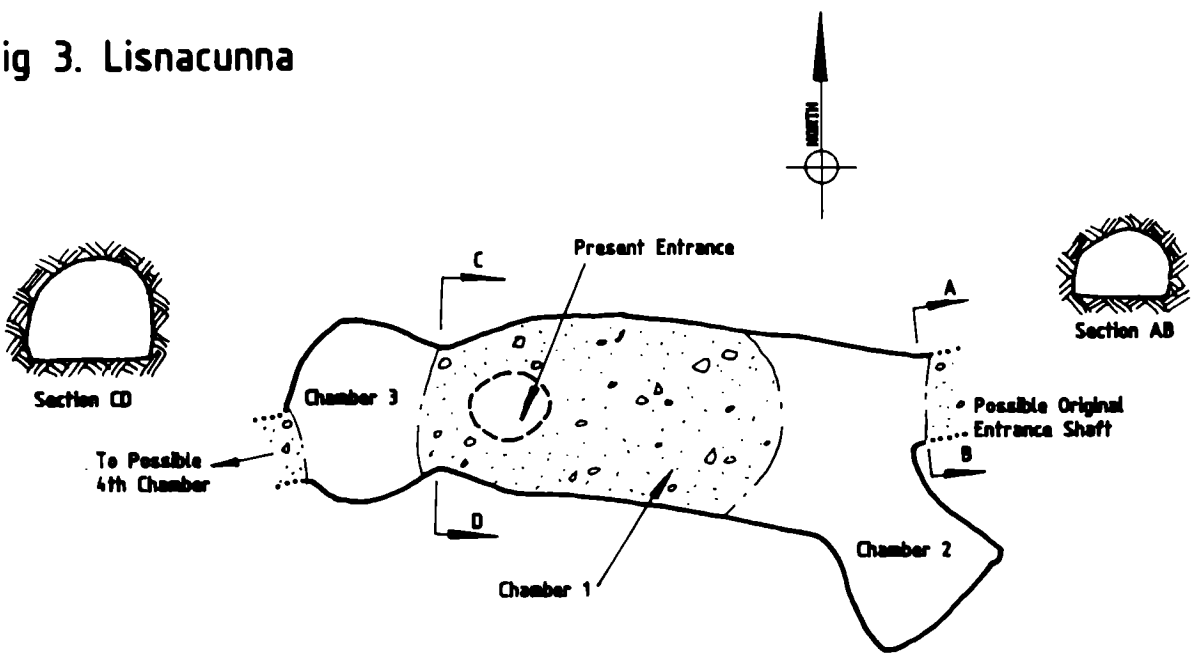


Fig 3. Lisnacunna



consisted of at least three chambers. It may have been associated with a ploughed-out ringfort still visible as low banks surrounding the former which was not, however, recorded on the 1st or 2nd editions of the Ordnance Survey 6" maps.

Chamber 1

Most of the roof had caved in of this rectangular chamber, 3.3 m E-W and 1.3 m N-S, and it was not possible to estimate the original height of it. A creepway filled with humic clay leads from the E side of the chamber, about 65 cm wide and 45 cm high (Fig. 3, Section A-B) and may have been the original entrance shaft.

Chamber 2

This is on the SE of Chamber 1; roughly square in plan, it measures 1 m NW-SE and 80 cm SW-NE. The entrance to Chamber 2 is only slightly narrower than the chamber, i.e. 65 cm.

Chamber 3

Sited on the W side of Chamber 1, it is entered through a creephole 80 cm wide and 66 cm high (Fig. 3, Section C-D). This circular chamber has a diameter of about 1 m. A creepway on its W side may have led to yet another chamber but this had been blocked and it was not possible to survey farther.

Discussion. This souterrain belongs to McCarthy's[6] Type D which is a miscellaneous group. Type D souterrains frequently have a passage and chambers of both rectangular and circular plan.

MONEYGAFF WEST (Fig. 4)

This earth-cut souterrain[7], consisting of six chambers lies within a levelled ringfort. It had been open for some time prior to the survey in the spring of 1984.

Chamber 1

Entry to the souterrain was gained through the collapsed roof of this rectangular chamber, which measures 2.7 m N-S and about 1.5 m E-W. The N wall was formed by a construction shaft (Fig. 4, Section A-B) which was infilled with five courses of sandstone. A creepway led from the W wall and may have been the primary entrance shaft. A second construction shaft was recorded in the W wall. A small recess, trapezoidal in plan and about 1 m long, occurred on the E side of the chamber (Fig. 4, Section C-D). The entrance to Chamber 2 was formed by a creephole about 70 cm wide.

Chamber 2

Irregular in plan, this chamber measures 2 m N-S with a maximum 1.7 m E-W alignment and a 90 cm height (Fig. 4, Section E-F). The creepway to Chamber 3 is 70 cm long and 40 cm wide. The actual opening into Chamber 3 had been narrowed by the placing of two large boulders against the E wall of the creepway (Fig. 4, Section G-H).

Chamber 3

This is at a right angle to Chamber 2 and is rectangular. It measures 3.8 m E-W, 1.5 m N-S and is 1 m high (Fig. 4, Section K-L). A construction shaft forms part of the W wall. The creepway that leads to Chamber 4 is 1 m long and 30 cm wide at ground level. Two earth-cut steps at either side of the creepway make it narrow on the ground but it is about 60 cm wide at a higher level and comparable to the entrance into Chamber 4 (Fig. 4, Section M-N).

Chamber 4

This is on the same axis as Chamber 3, also rectangular, and measures 1 m E-W, 90 cm N-S and 1.1 m high (Fig. 4, Section O-P). The creepway to Chamber 5 is 1.5 m long. The N wall of this consists of a low step on which a construction shaft was built (Fig. 4, Section Q-R), having an appearance of a large stone-built column jutting out of the N wall.

Chamber 5

In plan, this is irregular, measuring 2 m E-W and 1.8 m N-S. A construction shaft was recorded in the E wall and some collapse has occurred in this area. A small circular recess, about 70 cm in diameter, was recorded in the N wall. The creepway into Chamber 6 is 50 cm wide, long and high (Fig. 4, Section S-T).

Chamber 6

This chamber is C-shaped and measures 4.7 m E-W, 1.5 m N-S and 1.3 m high. Forming part of the SE wall is a construction shaft with a small drain, 15 cm high and 25 cm wide, leading from its base (Fig. 4, Section U-V).

Discussion. This souterrain belongs to McCarthy's Type C3. It was exceptionally well built and had a number of noteworthy features. The recesses of Chambers 1 and 5 seem to be original features. McCarthy (1977, *op cit*, 141-2) noted similar recesses in a souterrain at Ardgroom Outward 3 but dismissed them as being recent in origin. The recesses at Moneygaff West appear to be primary and, if so, are unique in Co Cork souterrains. The creepways between Chambers 2-3, 3-4 and 4-5 were deliberately narrowed by the builders; jamb stones were inserted in the creepway between Chambers 2-3 while the construction shaft considerably narrowed the creepway between Chambers 4-5. The low earth-cut step also constricts the entrance to Chamber 4. The deliberate narrowness of the creepways and the recesses may indicate that the site was used as a refuge; narrow creepways would obviously hinder easy access for intruders from one chamber to another while the recess in Chamber 1 was opposite the entrance shaft and may have been a defensive element. The drain in Chamber 6 was probably functional.

INCHYDONEY ISLAND (Fig. 5)

This souterrain[8] was earth-cut and consisted of at least six chambers. It was discovered in April 1985, again during ploughing. The site is adjacent to the mediaeval parish church and graveyard of Inchydoney. The

Fig 2. Bengour West

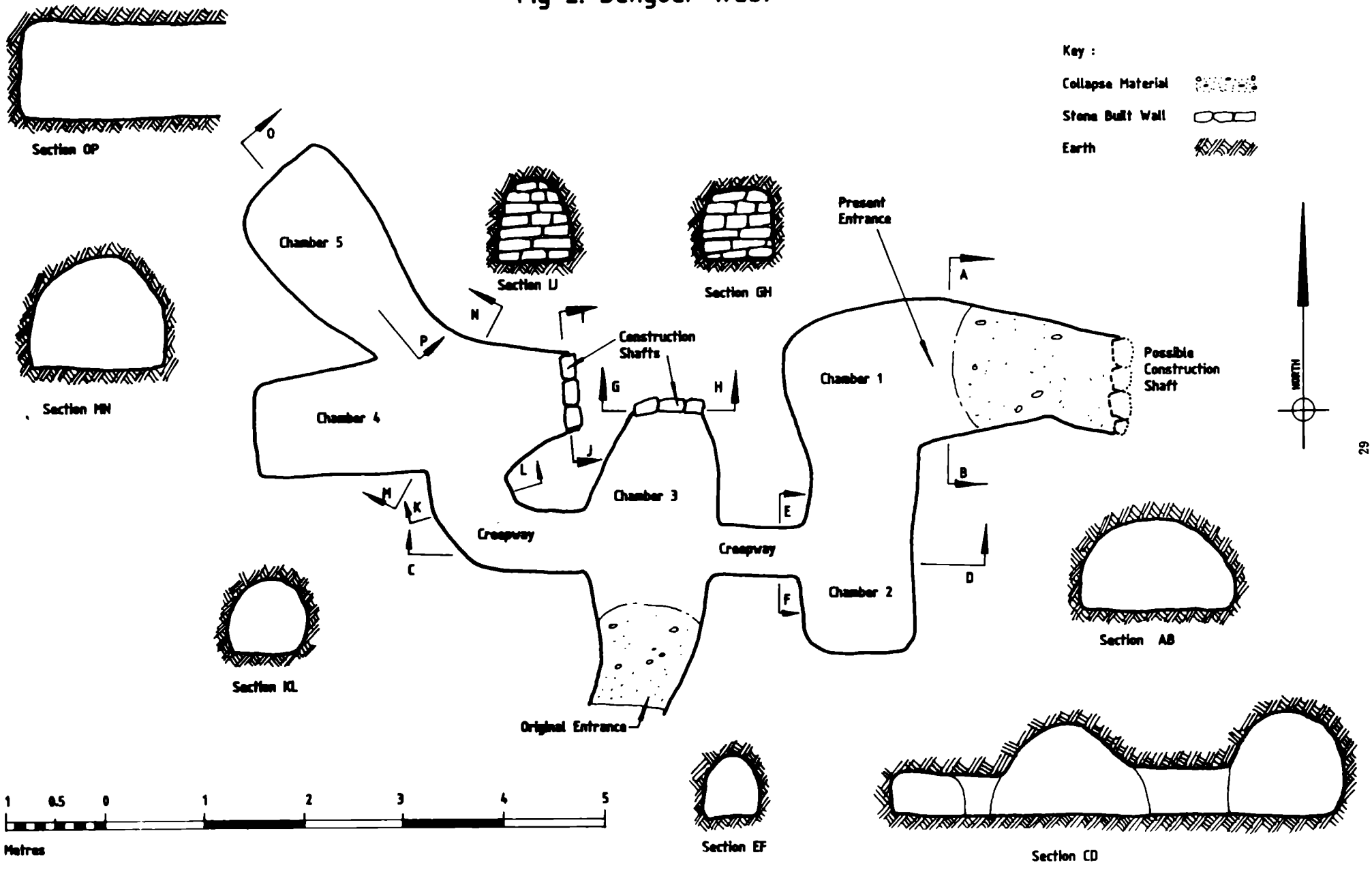
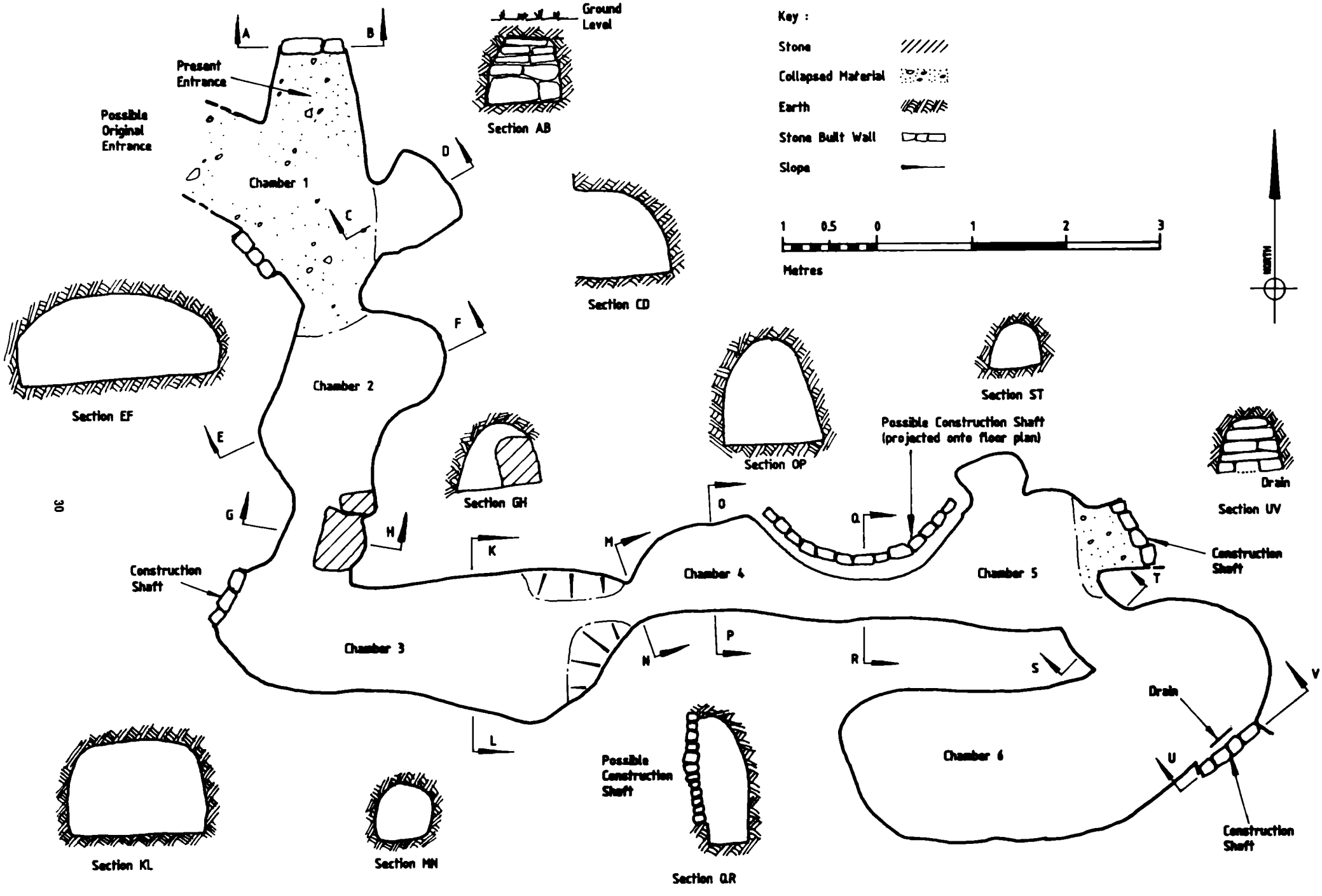


Fig 4. Moneygaff West



souterrain may suggest that an Early Christian church also stood at this location; however, there is no trace of any visible earthworks adjacent to the site.

Chamber 1

This, a rectangular structure, measures 2.5 m E-W and 1.2 m N-S: the floor is covered by soil shed from the ceiling and therefore it was not possible to estimate the original height. A lintelled creepway was recorded on the NE side of the chamber which may be the original entrance to the souterrain. A second creepway leads from the S side of the chamber but was inaccessible because of loose soil.

Chamber 2

The second chamber about 3 m E-W by 1.3 m N-S was almost completely filled by shed soil from the ceiling and walls, and only an approximate survey was possible.

Chamber 3

This is rectangular and measures 4 m E-W by 1.7 m N-S. The height is 90 cm maximum (Fig. 5, Section A-B). The E section of this chamber is blocked by what appears to be ancient collapsed material which has become compacted. The creephole to Chamber 4 is circular, about 70 cm in diameter.

Chamber 4

The entrance is through the roof; the chamber, which is rectangular, measures 4.2 m N-S, 1.4 m E-W and is a uniform 1.2 m high. The creepway to Chamber 5 is unusual in that it consists of a circular opening, about 70 cm wide, and descends by a steep drop into Chamber 5 (Fig. 5, Section G-H).

Chamber 5

This is irregularly shaped and measures 3.2 m E-W, 1.5 m N-S and 1 m high. A construction shaft (Fig. 5, Section K-L) forms the N wall of the chamber. The creephole to Chamber 6 is 1 m wide and slopes upwards.

Chamber 6

Also irregular in plan, the E and W walls of this chamber have construction shafts (Fig. 5, Sections O-P and Q-R). Part of the construction shaft on the E wall has collapsed. The chamber measures 2.7 m N-S, 2 m (maximum) E-W and is about 80 cm high. Numerous rat bones were visible on the floor and it is possible that these rodents had burrowed into the souterrain after it had gone out of use.

Discussion. The souterrain belongs to McCarthy's Type C3. The only unusual feature is the steep drop between Chambers 4 and 5. A number of cockle shells were scattered on the floors, randomly distributed throughout, and did not appear to be food remains. Numerous cockle shells were also obvious in the field above the souterrain which appeared to be part of a sand dune. The rat bones are likely to post-date the use of the souterrain since the bones are mediaeval and later in date[9].

CARRIGROE (Fig. 6)

This site[10] was discovered in April 1985 during the construction of a farm access road. It is adjacent to a church site[11] and appears to have been constructed near part of the church enclosure bank. A stone foundation of a building on the hilltop may be part of the original church. Local tradition associated the site with a *cillín* (burial place for unbaptised children, associated with the church). The souterrain was earth-cut and consists of three chambers.

Chamber 1

This rectangular chamber measures 4.85 m NW-SE and 1.6 m NE-SW, and has a maximum height of 1.25 m (Fig. 6, Section A-B). A lintelled creepway leads from the SW side. The lintel is supported by side stones. A complete survey of this area was impossible because the creepway was blocked by soil: it was probably the original entrance to the souterrain. A second creepway, 2 m long and 60 cm wide, leads from the N wall of Chamber 1, decreasing in height towards Chamber 2 (cf. Sections C-D and G-H).

Chamber 2

Access to the whole souterrain was gained through the roof of this chamber. Roughly rectangular, it measures 4.2 m N-S and 1.5 m E-W. A considerable amount of soil, fallen from the ceiling, covers the floor, consequently it was not possible to estimate its original height. A construction shaft forms the N wall of the chamber, being 90 cm high and infilled with large stone blocks. A creepway on NE side leads to Chamber 3. This is also blocked by soil and measures 1.2 m in length, 55 cm wide and 55 cm high at the entrance to Chamber 2 (Fig. 6, Section I-J). The creepway slopes upwards towards Chamber 3.

Chamber 3

The SE section of this chamber is in a ruinous condition and has completely collapsed. The NW wall is formed by a construction shaft, 80 cm high and wide. A creepway may have led from the SE side but this area was blocked with soil and it was not safe to proceed with the survey.

Finds

A mandible of a young horse and two lumps of iron slag were recovered from Chamber 1. The iron slag appears to be from a failed smelt.

Discussion. This souterrain belongs to McCarthy's Type C3. If associated with the adjacent church site, the souterrain may indicate that the church site belongs to the Early Christian period.

ACKNOWLEDGEMENTS

I would like to thank the landowners at each site for their co-operation; Mr M. Hurley and Mr B.O. Donnabhain for assistance during the survey; Ms M. McCarthy for identifying the horse mandible from Carrigroe; and Ms A. Desmond for typing the report.

Fig 5. Inchydoney Island

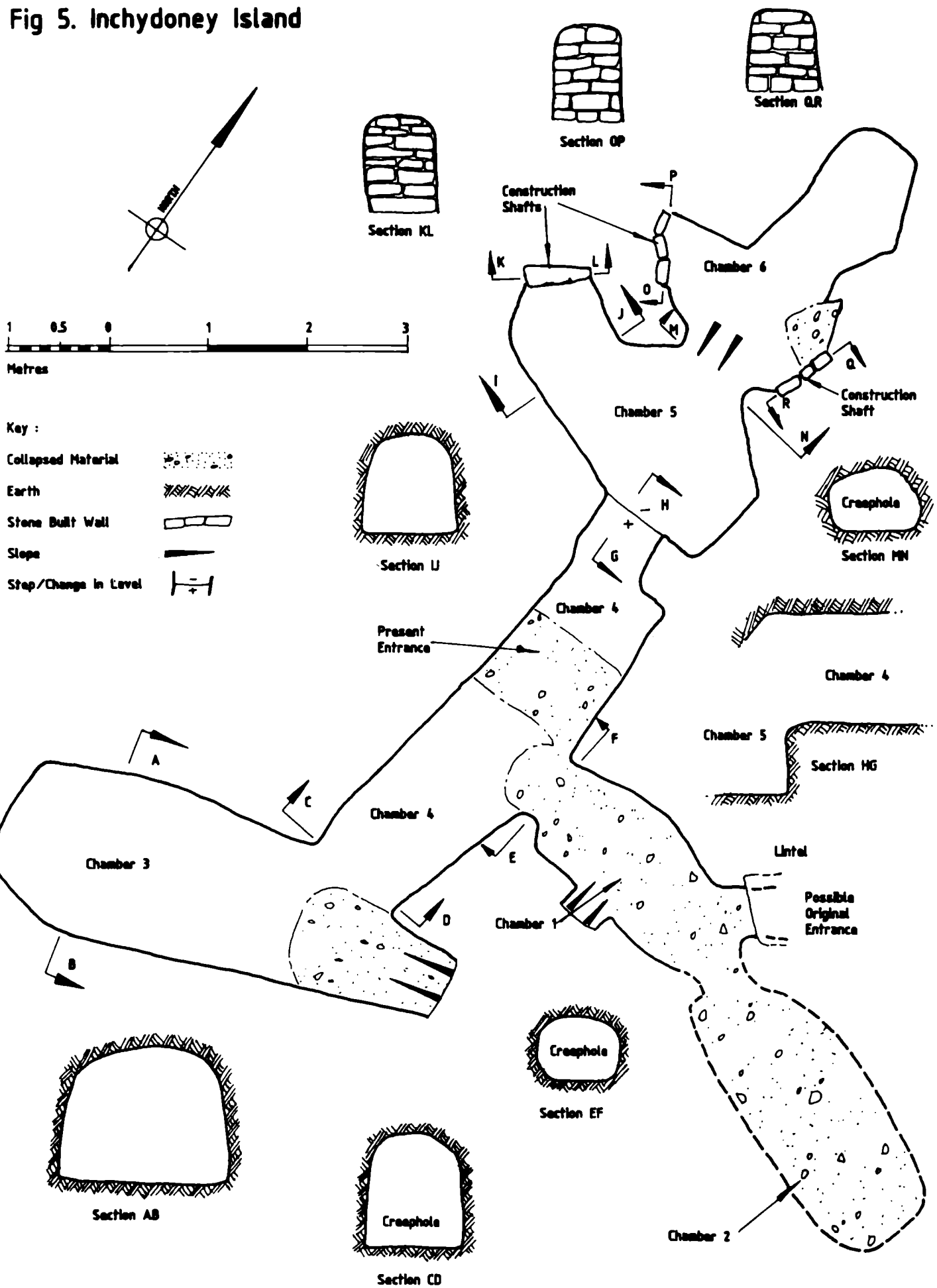
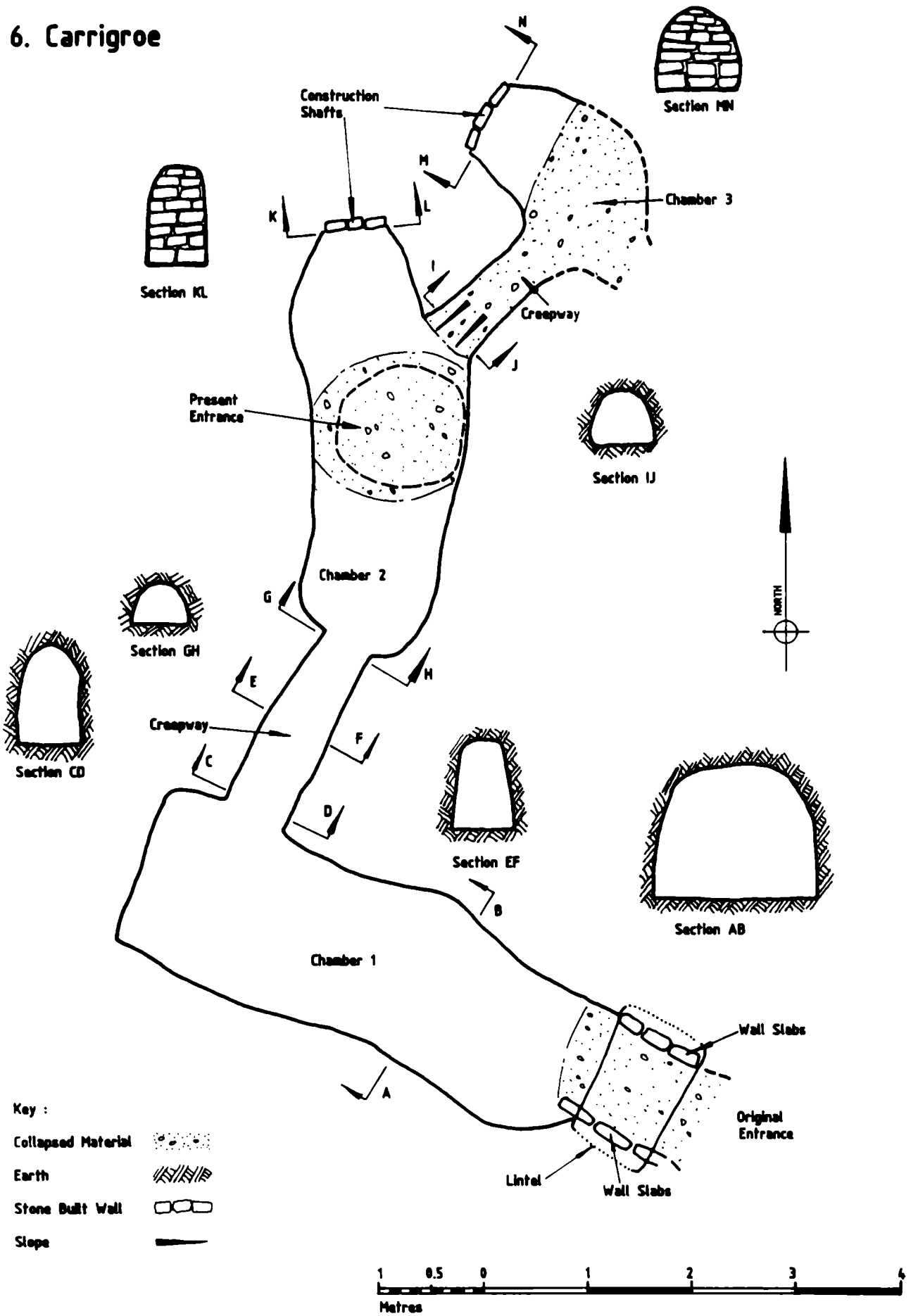


Fig 6. Carrigroe



NOTES

1 Exact location: O.S. 6" map sheet No 72, Co Cork: 24.7 cm from W margin; 6.7 cm from S margin. Barony: East Muskery; Parish: Aglish; Td.: Knocknagoul; about 440' above O.D., N-facing slope.

2 Exact location: as for note 1.

3 McCarthy, J.P. (1983), "Summary of a study of Co Cork Souterrains": *J. Cork Historical and Archaeological Society*, v. 88, pp. 100-105.

4 Exact location: O.S. 6" map sheet No 95, Co Cork: 38.8 cm from W margin; 14.8 cm from N margin. By. Kinalmeaky; Ph. Murragh; Td. Bengour West; about 700' above O.D., E-facing slope.

5 Exact location: O.S. 6" sheet No 122, Co Cork: 2.4 cm from N margin; 24 cm from E margin. By. East Carbery; Ph. Desertserges; Td. Lisnacunna; about 250' above O.D., S-facing slope.

6 McCarthy, J.P. (1977), *The Souterrains of Co Cork*. Unpublished MA thesis, Department of Archaeology, University College Cork.

7 Exact location: O.S. 6" map sheet No 94, Co Cork. 16.2 cm from N margin; 2.7 cm from E margin. By. East Carbery; Ph. Kinneigh; Td. Moneygaff West; about 650' above O.D., S-facing slope.

8 Exact location: O.S. 6" map sheet No 135, Co Cork. 57.4 cm from W Margin; 18.6 cm from S margin. By. East Carbery; Ph. Island; Td. Inchydoney Island; about 100' above O.D., S-facing slope.

9 McCormick, F. (1982), "Animal bones from a souterrain at Garryntemple, Co Tipperary", in *The Archaeology of the Cork-Dublin Natural Gas Pipeline*. Pre-publication copy in the Department of Archaeology, University College Cork.

10 Exact location: O.S. 6" map sheet No 134, Co Cork. 1.8 cm from E margin; 2.7 cm from S margin. By. Ibane and Barryroe; Ph. Rathbarry; Td. Carrigroe; about 200' above O.D., W-facing slope.

11 Exact location: as for note 10. Co-ordinates: 1.2 cm from E margin; 3.1 cm from S margin.

WESTERN TURKEY - SUBTERRANEAN AND GEOLOGICAL FEATURES AS TOURIST ATTRACTIONS

Dr Ivor J. Brown

The following summary is part of a report on a study tour undertaken in Western Turkey by the writer as a Cook Fellow, examining the various ways geological phenomena and subterranean features (both natural and man-made, including all aspects of the mineral producing industry) could be developed as an aid to the development of tourism.

The attractions as at present developed include:

1. Features in the Istanbul area, particularly its mosques and palaces including cisterns.
2. The ruins of earlier civilisations along the western coast.
3. The natural features, caves and waterfalls in the vicinity of the southern Mediterranean resorts, particularly around Antalya and Alanya.
4. The natural and historic features between Denizli and Konya, the Turkish Lake District, the crystal falls of Pamukkale and the museums of Konya, among others.
5. The natural wonders, rock-cut dwelling places, churches and spectacular subterranean frescos in the Cappadocia region.
6. The craft industries based on natural resources.
7. The Mining Industry.

These include carpet and leather workshops, potteries and onyx factories. At present the industrial aspects have not yet been developed into tourist features; the steam operated railways, the mines and quarries are scattered throughout the region, often in isolated places. Only the specialist 'theme' tours and more leisurely package tours offer the opportunity of such visits.

1. **Istanbul Area.** The treasures of Istanbul are the mosques and palaces all well known to the tourist and consequently well developed.

   Of more direct interest to this study, however, are the ancient water cisterns beneath the city, particularly the Byzantine cistern, 140 m long by 70 m wide with 336 Corinthian columns. This underground palace, although open now in a limited way, could be developed further - boat trips could be offered, for example.

   The city's short underground railway system (less than 800 m) dating from 1867, could also be developed for tourists and perhaps even extended to advantage. The European Railway Station, destination of the famed Orient Express, is still in use but could be popularised as a transport museum. There is already a steam locomotive on display at the entrance.

2. **The ruins of earlier civilizations along the western coast** include, amongst many others, the Acropolis and Asklepieion (with its 100 m long tunnel).

3. **The natural features, caves and waterfalls of the southern resorts.** With one fifth of its total area consisting of limestone terrain the prospects of finding caves suitable for medicinal/tourist use is excellent, indeed some have already been developed. Similarly other karstic forms such as sinkholes, springs, waterfalls and canyons abound. Most of these are found in SW Turkey and in particular S of Afyon.

   The principal area of caves is in the triangle between Antalya, Valvac and Alanya. The caves can be classified into three types: historical caves, decorated caves and sea caves. Some of the oldest habitation centres in the area are based on the Karain Cave and the Beldibi Cave while many hundreds more have been utilised by man at various times. The Damlatas Cave is a good example of a decorated cave and is now electrically lit, with information given to visitors by loudspeaker. At least two sea caves are used regularly as show-caves at Alanya. The Phosphorus Cave or Blue Grotto is large enough for boats carrying 30 passengers to enter. At the Kizlar Magarasi (Maidens Cave) boats may enter and land their passengers for exploration and fishing. Some caves are used for medicinal purposes; at the Damlatas Cave and the Insuya Cave near Isparta visitors normally stay underground up to 3 hours, the recommended period for asthmatic treatment. There are also decorated show caves at Cennet, Cehennem and Duden Obruger. Other important caves are Yarimburgaz Cavern near Istanbul with chambers up to 20 m high and the Dudencik Cave at Cevizli, the deepest known cave in Turkey, with a depth of 330 m.

   Scenic waterfalls abound in the limestone area and Antalya itself has been called "the city of cataracts" since water falls from the steep cliffs to the sea. One of the most impressive of these is the Duden Waterfall. The Manavgat and Varsak Waterfalls, both in the Antalya area, are on rivers, they are of shallow height but impressive in width and the latter has caves which can be entered behind the falls.

4. **The natural and historic features between Denizli and Konya.** These include the 'crystal falls' of Pamukkale, the Turkish Lake District and the stone buildings of Konya. The thermal Pamukkale Springs at the foot of Mount Salpakos have been an attraction for visitors since at least the 3rd Century BC, in fact the site of the ancient city of Hierapolis, the ruins of which now cover the area around the springs, was chosen for this reason. Many one-time visitors have chosen to die here and the Necropolis of Hierapolis is possibly the most interesting ancient cemetery in the world. The 1200 tombs cover all periods back to the early years of the city and over 300 still retain their original inscriptions. The tombs range in type from subterranean tumulus to the raised sarcophagus.

   Near the Pamukkale Spring there was a hole in the ground known in recent times as the Pit of the Jinn but formerly as the Mouth of Hell. Before being sealed for safety, this hole was famous for its life-extinguishing atmosphere mentioned by Strabo and many others. The priests of Apollo and later Christian priests claimed miracles after having survived a walk into the hole (while holding their breath!). Some guide books say the gas was carbon monoxide, others that it was carbon dioxide; most probably it was the latter. It is possible that this underground feature, if reopened, could form an additional attraction for this area.

   Konya has many buildings of great historic interest, most of which are now important museums of specialist interest including the Karatay Medresesi (ceramics), Ince Minare (museum of stone and wood works) and Mevlana Mosque/Museum (museum of the Whirling Dervishes). There are also some important mosques and mausoleums exhibiting fine stone masonry, stone sculpturing and tile decoration. So much remains of fine quality that the town could become an open air museum of stone and wood works. Of special interest in this area are the wells with their typical spar-timber frame hoist and the fountain heads at the mosques.

5. **The natural wonders, rock-cut dwelling places, churches and spectacular subterranean frescos around Cappadocia*.** The Cappadocia area is surrounded by arid, desert-like steppe-lands dotted with substantial fortified caravanseries, overnight staging posts on the great caravan routes of former centuries. Behind all this and on each side of the area are the snow-capped peaks of the two major dormant volcanoes Hasan Dagli (3243 m) and the Erciyas Dag (3917 m) and their associated mountain ranges. Tuz Golu, the great salt lake, is also in this area.

   Cappadocia lies in a triangle with Nigde, Nevsehir and Kayseri at its corners, covering an area of 4000 sq. km and forming a plateau 1000 m high. The surface rock of the area was formed by the lava and ash that came from the volcanoes, particularly Erciyas Dag, thousands of years ago. These hardened to form tuffs and basalts of varying resistance, which over the years have been eroded by wind, snow and rain. Some parts were eroded much faster than others and this has resulted in deep valleys and 'fairy chimneys', pillars of softer rock up to 30 m high and each protected by a harder capping. The softer rocks have been cut and chiselled into rooms and tunnels to form homes, shelters and churches from 3000 BC right up to the present day.

   The area's attractions include the unique 'fairy chimneys', deeply incised valleys, massive steep-

*See also article by Helen Mulligan, Subterranea Britannica Bulletin No. 23.

sided "rocks", underground cities, rock churches (many with beautifully coloured frescos), the underground monasteries and the fort-like caravansaries.

Local products include onyx jewellery and utensils, clay pots, carpets and wine.

The erosion caused by wind and weather has formed the tuff into a strange landscape of towering cones, pyramids, monoliths and numerous valleys which must be one of the geological wonders of the world. The cones and pyramids can probably best be seen in their natural form around Zelve although even here many have rooms cut into them. The steep-sided "rocks" or monoliths such as at Ortahiser and Uchisar are often large enough to support complete multi-story subterranean towns. The valleys too have had their sides cut and carved to form subterranean communities in a similar manner.

On the flatter plains, underground cities of many storeys have been dug, two examples of which are at Derinkuya (eight storeys now accessible to a depth of 80 m) (see Figure 1) and at Kaymakli (four storeys accessible) but up to 300 other underground cities are known. It is believed that some of these were capable of providing protection for up to 10,000 people.

In the cones and in the base of the rockwalls, monasteries and churches have been cut. Some have sculptured features on the walls and ceilings and some have been decorated with paintings either directly on to the wall or on to plaster. It is believed that while some of the paintings date back to earlier than the 9th Century AD, most date from the 10th-11th Century to the 13th Century with a few more recent than this.

Often there are guide books available with pretty pictures, but text of doubtful accuracy.

Examples of the main types of features are given below:

(i) The steep sided rock or monolith of Urchisar, perhaps 70 m high, with a multitude of subterranean rooms or cells, has some still in use for the storage of fruit. The entrance is controlled but there are few safety measures along the steeply climbing footpath to the top.

(ii) Goreme is a principal valley containing numerous rock-cut dwellings, churches and monasteries and a large area of 'fairy chimneys'. It is now an 'Open Air Museum' with controlled access. The valley contains some of the finest decorated subterranean rooms in the area, a few of which were still in use as churches until 1924.

(iii) Zelve is reached via a valley containing a forest of 'fairy chimneys' and consists of an ancient town of cliff dwellings abandoned finally as recently as the 1950s. Abandonment was caused by the dangers due to the spalling away of the cliff faces under the effects of erosion. The community was for many years a mixed Christian-Moslem settlement with mosques and churches. Entrance to the site is controlled.

(iv) Four of the underground cities are now open to the public; Derinkuyu, Kaymakli, Ozconak and Sogandi. Access is controlled but although the tunnels are fairly well lit electrically many of the passages are steep, low and narrow. Guides are also advisable in the labyrinth of tunnels both for direction purposes and to indicate important features.

(v) There are numerous freely accessible disused souterrains and others are still in use as outbuildings, stores and dove-cotes. A few are in use commercially, for example the Papgan Restaurant at Goreme is in a rock furnished as a typical Turkish troglodyte dwelling. At the entrance to this restaurant a local lady demonstrates daily the making of traditional pancake style unleavened bread.

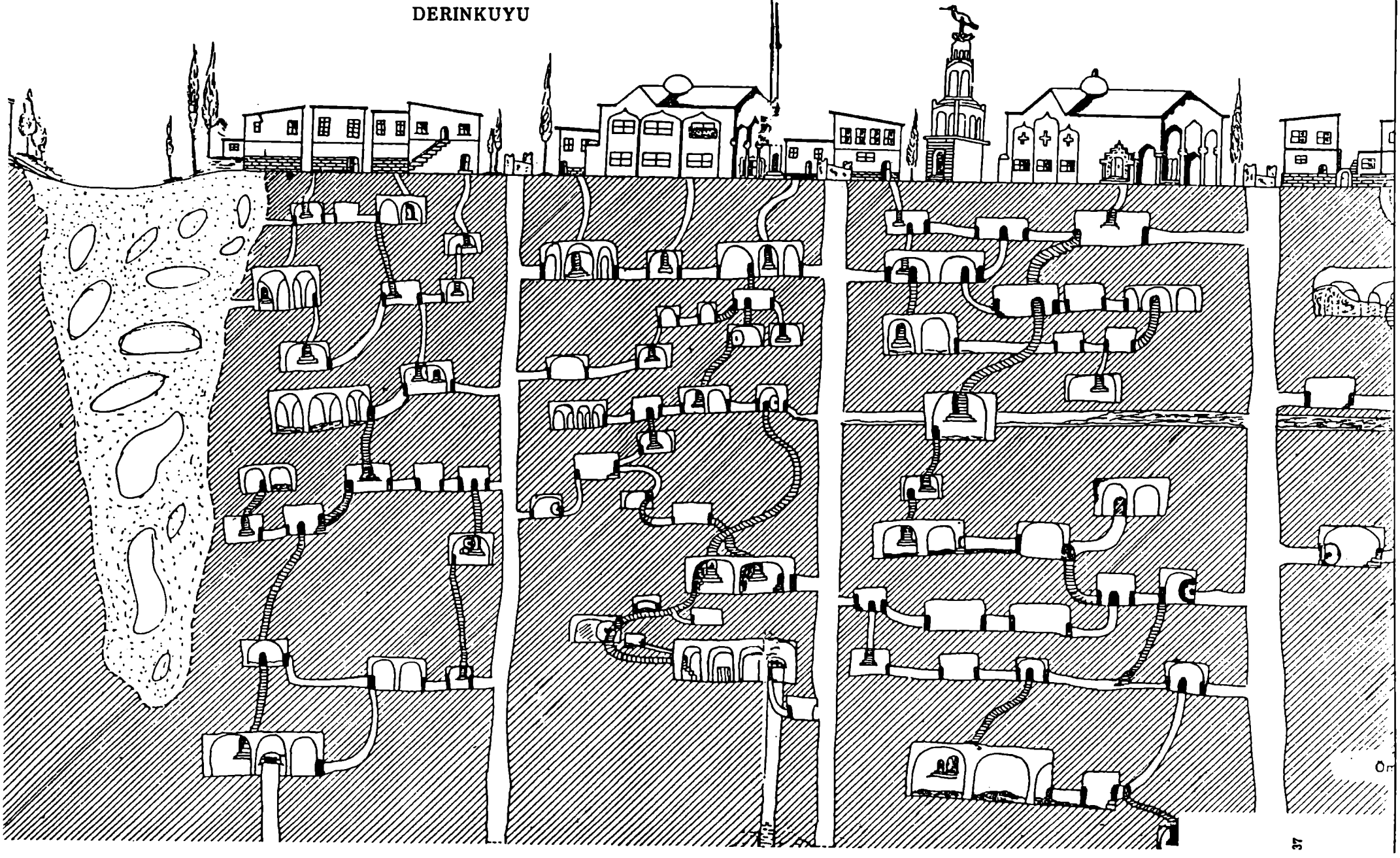
6. **The craft industries.** Some craft centres such as that of carpet making have been developed over the whole country while others like onyx manufacture and pottery production are restricted to one or two locations.

The town of Avanos in Cappadocia is situated on the Red River, so named because of its contact with the local red clays. It is famous for its pottery and is the base for numerous potters who work in subterranean cellars on a steep hillside. Visiting parties are encouraged and are provided with seats set in a square around a potter's wheel where a simple demonstration takes place. The visitors are then provided with small pots of local red wine. A wide range of pottery is produced and put on display for sale in the labyrinth of passages beneath the steep hillside. The clay is dug from quarries about 2 km away where it is first separated and graded before being brought in for use. The potteries visited included Chez Mehmet, La Poterie Artisanale and Chez Galip, La Caverne du Potier Yanalak, both of Avanos.

The Cappadocia area is also famous for its Onyx products. The onyx is mined from a shaft 75 m deep situated 48 km away from the Ucler Onyx Factory. The factory is open to the public who can see the arrival of the rough onyx, its cutting into blocks using large rotary saws, its rough shaping by men and finally polishing by a team of small boys 13-14 years of age. The tour is well organised but safety standards appear to be low.

7. **The Mining Industry.** There are many ancient metal mines recorded and in fact Turkey has been called 'the cradle of mining'. However, few papers are available on the history of specific mines or mining areas in the country. The types of mining and quarrying used today vary widely, including traditional ancient practices and the most modern techniques but large areas of minerals remain undevel-

Figure 1. THE UNDERGROUND CITY AT THE VILLAGE OF DERINKUYU



oped. Mining needs a good communications network, as does tourism, and this network is only now being constructed. Once the highways and railways are formed to the mines, tourism could well follow.

According to a leaflet provided by the Turkish Embassy, the principal minerals worked are:

(i) Hard coal (Eregli-Zonguldak Coal Basin)

(ii) Lignite (found over a wide area in Kutahya, Manisa, Amasya and Aegean regions)

(iii) Petroleum (Anatolia, Gaziantep and Adana regions)

(iv) Iron (Balikesir, Marmara, Aegean, Mediterranean, Sivas and Black Sea regions

(v) Copper (Ergani, Murgul and Kure)

(vi) Chromium (Anatolia, Kutahya-Bursa, Erganic-Maden, Eskisehir, Maras, Kayseri and Sivas

(vii) Bauxite (Konya Region).

There are also mines for sulphur (Isparta), mercury (Izmir and Konya) and lead-zinc, among others.

The most important mining operator in Turkey is Etibank. This is a 100% state-owned organisation set up in 1935 with the purpose of exploiting the minerals that are explored, extracted and studied by the Turkish Mineral Research and Study Institute. Although coal and iron were removed from Etibank's control in 1950 the company still employs 28,000 people producing such minerals as boron, copper, lead, zinc, bauxite, aluminium, chrome, sulphur and mercury. These are spread over the whole country and include both surface and underground mines. Most of the coal and lignite operations come under the jurisdiction of Turkish Coal Enterprises.

Of the other mineral extractive industries many of the operations appear small and of necessity close to the major highways. Some of the limestone quarries were still using hand-loading techniques, although others were mechanised. The lime kilns seen were equally diverse in type, ranging from the old field kilns to modern shaft kilns. Stone for road construction seemed to be obtained from borrow pits close to the site of use and these were not of great interest except in geological terms.

The building stone quarries were very interesting, however, particularly where the masons were still employed on site as in Cappadocia. Much of the marble was imported through the Sea of Marmara (which means marble) ports and this still occurs at Izmir on the Aegean Sea.

It is understood that much of the marble is produced by underground mining on the offshore islands.

The clay quarries serving the brickmaking and tile industries are usually shallow, up to 4 m deep, and cover large areas as at Denizli. They have no special interest. The works that they supply, however, are very varied, some are of the traditional 'brick banks' type, others are either of 19th Century kilns or modern types.

Blockmaking using sand, cement and water is carried out in most towns on a large scale and frequently this also takes place on the building sites themselves.

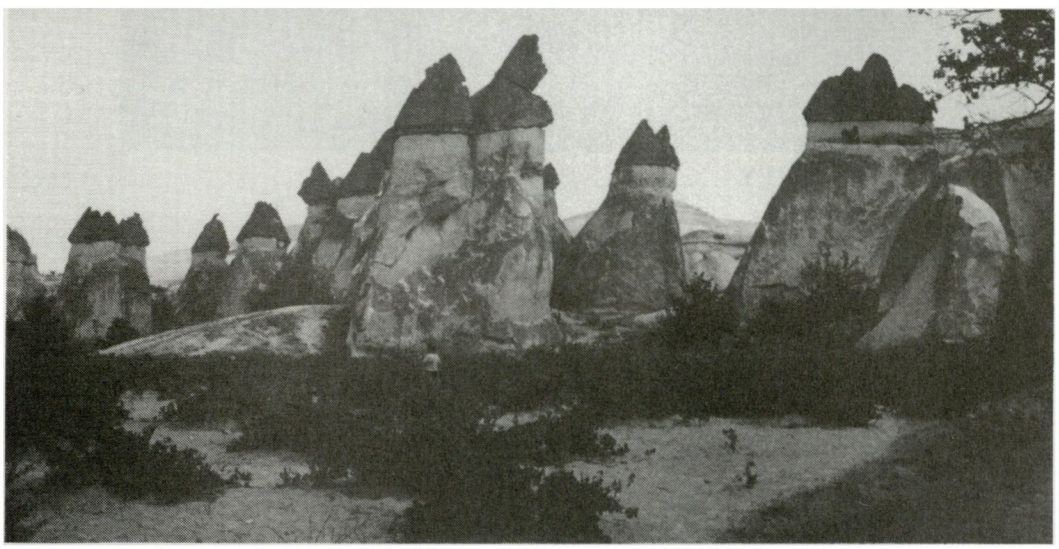
In general, except for the building stone industry, there does not yet appear to be much to interest the visitor in the surface mining field. However, some large open pits are now being developed which could form interesting viewing in the future. There are many interesting mining sites close to the established specialist Crusader and Cappadocian Tour routes, for example lignite mines near Canakkale, iron, lead, silver and copper mines in Anatolia and argentiferous-lead mines near Konya as well as mercury mines near Aydin. At present there is little interest shown by visitors in going underground even in the existing show caves. On very hot days, when holiday-makers are looking for somewhere cool, they seem to prefer to journey up a mountain, never far away by air-conditioned coach.

The rock churches, houses and underground cities appear to attract a growing interest which is being pursued actively by the Ministry of Information and Tourism. This applies too to the thermal springs but in both cases care will have to be taken as too many visitors will destroy the features that they have come to see.

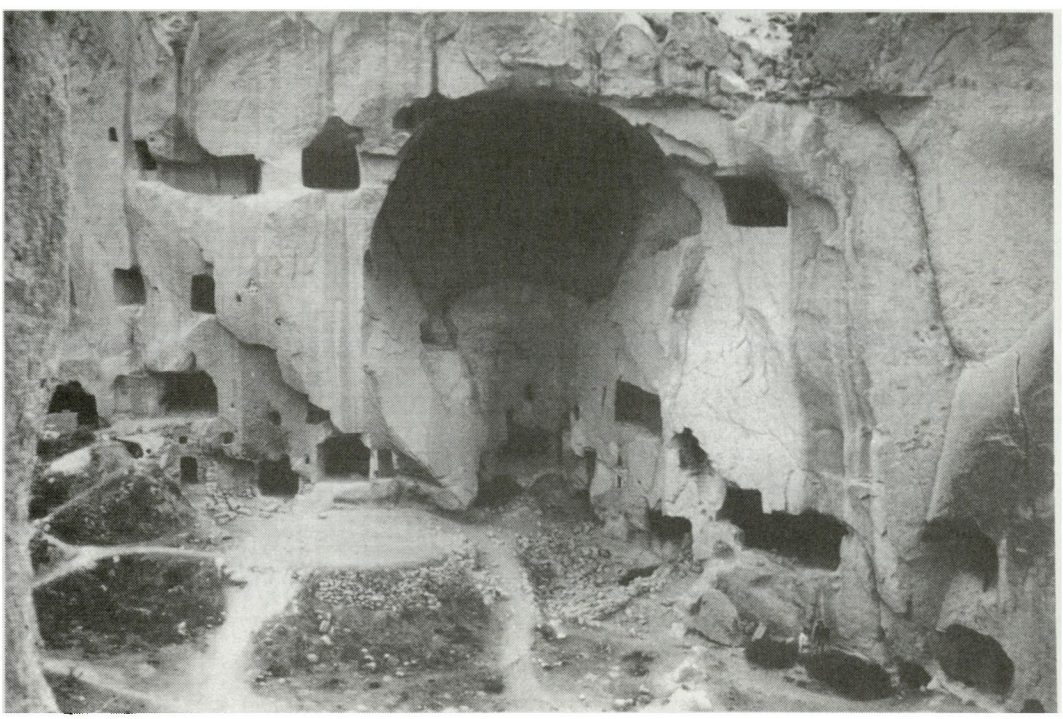
Bibliography

1. Turkey (1968), Nagels Encyclopedia - Guide pub.
2. Freely, J. (1979), The Companion Guide to Turkey: published by Collins.
3. Fodor's Guide to Turkey (1980).
4. Schneider, D. (1975), The Travellers' Guide to Turkey: published by Cape.
5. Turkey (and regional leaflets) (1981): published by the Turkish Tourism and Information Office.
6. Ephesus Guide: published by Isteme Addressi Mahmut Camci, Izmir (undated).
7. The House of Our Lady, Ephesus: guide published by The Mary's House Association (undated).
8. The Seven Churches by Zaferyap Gurtan (undated).
9. Urchun, E., Antalya (undated).
10. Karstic Forms in Turkey - Caves and Caverns (1981): information leaflets from the Turkish Embassy, London.
11. Gokovali, S., Pamukkale: published by Ticaret Matbaacilik A.S. (undated).
12. Demir, O., Cappadocia - Cradle of History: published by the Author (undated).

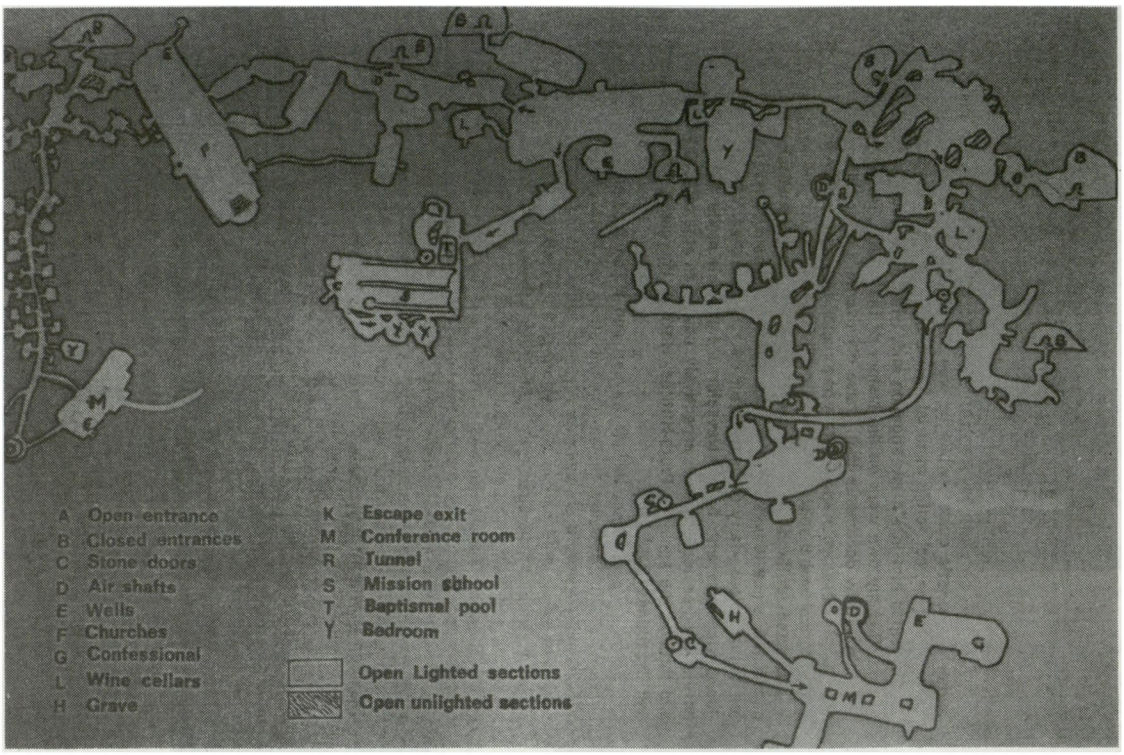
Derinkuyu



Zelve



Zelve



PLAN OF DERINKUYU, TURKEY

CAVE WALL PAINTINGS AT GOREME, TURKEY